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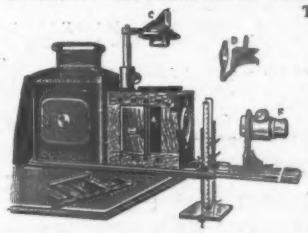

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June 24, 1920.

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JUNIOR ENTOMOLOGIST.—Initial pay £E360 plus bonus.

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JUNIOR CHEMIST.—Initial pay, £E360 plus bonus.

Note.—The Egyptian Government bonus referred to consists of an increase of 20% to salaries and in addition a war gratuity of 60% on the salaries so improved, provided that the increase from the war gratuity does not exceed £E192 per annum and that the total increase from both sources of increment does not exceed £E300 per annum. The Pound Egyptian is worth about sixpence more than the Pound Sterling.

Candidates are expected to be in possession of Honours Degrees in Science, and in the case of the chemical appointments, preference will be given to Fellows or Associates of the Institute of Chemistry.

Applications, together with statements of qualifications and references, which will be received up to July 15, 1920, should be endorsed "Research Staff, Egyptian Ministry of Agriculture," and addressed to SIR ARTHUR WEBB, K.C.M.G., Queen Anne's Chambers, Broadway, Westminster, from whom all particulars regarding conditions of service, etc., can be obtained.

MINISTRY of AGRICULTURE, EGYPT.

The Ministry of Agriculture, Egypt, invite applications for the undermentioned appointments on its Agricultural Staff at Cairo. Candidates are expected to be in possession of Honours Degrees in Science.

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THREE JUNIOR BOTANISTS.—Initial pay £360 plus bonus.

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THURSDAY, JULY 8, 1920.

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Medical Education.

DURING the last thirty years the feeling has become increasingly insistent, both in this country and in America, that certain radical reforms were needed in the methods of education in medicine. But our American colleagues have been fortunate in having the opportunity and the means for building new schools of medicine to meet the new circumstances and for making drastic changes in their methods of teaching which a variety of circumstances has hitherto prevented us from attempting in Britain. Now that the Rockefeller Foundation, by its magnificent generosity, has made it possible for us to embark upon the difficult sea of reform, it is particularly interesting and instructive to study the policy adopted in the more advanced schools of America during the twenty-seven years since the Johns Hopkins Medical School gave the study of medicine in America a new aim and a higher ideal. Though we are a quarter of a century behind our American colleagues in making a start, our delay has given us the advantage that we can profit by the experiments made on the other side of the Atlantic.

It is not generally recognised here how thoroughly the leaders of medical education in America explored every possible method of education throughout the world, and how much devotion and thought they have expended on experiments to discover, by truly scientific methods, how best to employ the few years that the medical student can devote to the training for his profession. Those who want to understand something of the spirit and the high ideals that have inspired the American leaders in this great reform movement should read the account of their work and aims in the volume "Medical Research and Education," issued by the Science Press in New York in 1913. Briefly expressed, the matters upon which chief insistence is placed are as follows: The absolute necessity of (*a*) an adequate preliminary education and a serious University training in the basal sciences, physics, chemistry, and biology, without which foundation it is impossible for the student really to profit from his training in medical science; and (*b*) a method of practical teaching in all branches of professional work, whereby the student can, so far as possible, investigate for himself the facts and theories of each subject under the direction of men who are themselves engaged in research work, and not rely mainly upon lectures and demonstrations to give him merely the *results* of other people's work. In other words, the aim of the reform is to train the student in scientific methods rather than to "cram" him with traditional lore.

So impressed were certain American teachers with the evils of the lecture system of instruction that the attempt was made to eliminate lectures altogether. On this side of the Atlantic (and in most American schools also) it is recognised that some lectures are essential to give the student guidance and a right perspective in his work, and that demonstrations are an invaluable means of instruction, provided the student can really see the objects and appreciate the significance of the experiments. No impartial observer will, however, refuse to admit that in most British schools an altogether undue amount of the medical student's and his teacher's time is wasted in the attendance upon lectures and demonstrations of a useless or distracting kind. Several circumstances make it difficult to break with this vicious system. The financial arrangements in most of our schools are based upon payments for certain courses of lectures or demonstrations: the requirements of most institutions and examining boards are for attendance at so many lectures: and the method of awarding the Board of Education grants for some time helped still further to stereotype this system. In the American schools the student pays for his instruction, and the teacher is free to decide how best the required instruction is provided; in other words, the method of administration of the department is so arranged that the perpetuation of obsolete and vicious methods is not made compulsory for a teacher who has his own ideas as to how to educate his students to the best advantage.

The other great reform in American medical educational practice has been to bring the methods of teaching and research in the clinical subjects into line with those of the intermediate subjects.

The teachers of medicine, surgery, gynæcology, etc., used to be men practising their profession who gave up a certain amount of time to teaching medical students. Such men could bring to their teaching the ripe experience gained not only in the hospital wards, but also in contact with private patients; and, in addition to teaching the science and practice of medicine, were supposed to be able to convey to the student something of the subtle art popularly known as the "bedside manner," which is sometimes reputed to be more useful to the practitioner than either knowledge or skill. But it has long been felt that such teachers, in the course of their individual careers, would become more and more strongly tempted to neglect teaching and research as the demands of their practices became more insistent, and that it was only the exceptional man who would be sufficiently interested in investigation and teaching to make the financial and social sacrifice which the cultivation of his scientific interests would inevitably entail.

British medicine, both now and in the past, has been extraordinarily fortunate in such "exceptional" physicians and surgeons, who have deliberately set aside part of their time for scientific research and teaching. But for their zeal, this country could not have acquired or maintained its deservedly high reputation for clinical research. Nevertheless, the fact has to be faced that in some of the hospitals attached to our schools of medicine no real research of any kind is being carried on, and the clinical teaching is of the most perfunctory order. The obvious remedy for this disastrous tendency is to appoint selected men to investigate the problems of medicine and surgery and to direct the education of students, who will devote the whole of their time to this work, as the professors of anatomy, physiology, pathology, and pharmacology do at present. Such a development has, in fact, become inevitable, for now that a real science of medicine is beginning to emerge the investigation of its difficult problems and the direction of the students' training demand the whole time and energy of specially selected men with the necessary technical training and self-denying devotion to science to cope with such tasks.

This system has been tried in America with most encouraging results. Acting on the advice of Sir George Newman, the Board of Education last autumn agreed to provide financial help to enable certain medical schools to introduce the system of full-time teachers of medicine and surgery in England. Of the institutions that availed themselves of this offer, the University College Hospital Medical School was the only one which adopted a really whole-time system; and it was this consideration that focussed the interest of the Rockefeller Foundation upon the Gower Street School, for in America the Rockefeller Foundation has played a large part in encouraging the adoption of the whole-time professorships of medicine and surgery. Another factor that played some part in determining its selection was the fact that University College had made provision in its Institutes of Physiology and Pharmacology for the adequate training of students in those subjects, so as to equip them to make the best use of the new facilities for clinical study in the medical school; and further that Prof. Starling had agreed to hand over to the department of anatomy the sub-department of histology, which is vitally important for the full development of teaching and research in anatomy.

The great development in the science of anatomy during the last thirty years has been due mainly to the use of the microscope for the investigation of the structure of the body and for the study of embryology. British anatomy has been hampered by the lack of the facilities for teaching these vital parts of the subject, and has suffered enormously from the lack of stimulating daily contact with them. In other countries, and especially in America, the cultivation of histology and embryology has not only made anatomy one of the most active branches of medical study and research, but also brought the work of the department into close touch with physiology, biochemistry, and pathology, to the mutual benefit of all these subjects, and especially to the student who has to integrate the information acquired in the different departments. It was the radical reforms effected in the teaching of anatomy by the late Prof. Franklin Mall at the Johns Hopkins Medical School in 1893 that played the chief part in starting the great revolution in medical education in America. The stimulating influence of the abolition of the methods of medieval scholasticism in anatomy and the return to the study of Nature and to the use of experiment brought about a closer co-operation with other departments and a general quickening of the students' interest in the real science of medicine.

The effects of these developments spread to other American schools, and the Rockefeller Foundation came to their help and contributed part of the cost of the vital reforms. In 1914 it helped the Washington University at St. Louis to build a new medical school and hospital, with full-time

professors of the clinical subjects, for the endowment of which it gave 250,000*l.*, a quarter of the cost. In 1917 it gave the Chicago University 500,000*l.*, and in ninety days the University collected a further 900,000*l.* to complete the endowment of full-time clinical chairs. In 1918 Yale University raised 650,000*l.* for the same purpose, of which the Rockefeller Foundation contributed one-quarter. In 1919 the Johns Hopkins Hospital established a full-time teaching staff in obstetrics and gynæcology, with an endowment of 250,000*l.*, of which the Rockefeller Foundation gave 100,000*l.* It is rumoured that the same Foundation, which has also given such vast endowments for medical education in Canada and China, is about to excel all its former efforts by a new scheme for further helping medical education in the United States. With such examples of the scale on which these things have to be done, surely England can do more for medical education than she is doing!

The task of the reformer of medical education is vastly more difficult in this country than in America, because on every side there is the hampering influence of cast-iron conventions; but now that the Rockefeller Foundation has helped us to begin the urgent reform there can be no doubt as to the ultimate result.

The Theory and Facts of Colour Vision.

(1) *The Physiology of Vision, with Special Reference to Colour Blindness.* By Dr. F. W. Edridge-Green. Pp. xii + 280. (London: G. Bell and Sons, Ltd., 1920.) Price 12*s.* net.

(2) *Card Test for Colour Blindness.* By Dr. F. W. Edridge-Green. 24 cards. (London: G. Bell and Sons, Ltd., n.d.) Price 25*s.* net.

(1) THE great importance of the subject-matter of the volume under notice and of the card-test which supplements it is beyond all question. Interest in it is enhanced by the fact that the subject is admittedly full of difficulties. In every discussion of human sensations and of the organs which serve as the receivers of stimuli, one is impressed by the uncertainty of much which has been put forward as assured truth. It is not long ago that the mechanism of audition was being discussed anew, and even now, in spite of the renewed examination, the functions of various parts of the ear are much in debate. Yet in audition we have to deal with purely mechanical stimuli which we might have expected to have yielded up the secrets of their operation long ago. In the case of light the problem is clearly of a more recondite order, and it is not so surprising that little is actually known with certainty about the functions of various parts of the eye, and that we have therefore to fall back upon surmise.

The theory of vision most espoused by physicists is the three-colour theory of Young and Helmholtz, based upon the facts of colour mixture. It is possible to reproduce any tint whatever by mixing together three selected tints in a suitable proportion. This is accepted now by every school, and it must be taken as the basis of any theory of colour vision. The Young-Helmholtz theory explains the fact by *assuming* that there are three units in the sensitive apparatus of the eye (either three sorts of nerves or rods or cones), each of which responds in a maximum degree to one of the three primary tints, but also to a less degree to all (or most) other tints. Red, green, and blue of selected wave-lengths are taken (for reasons which cannot be given here) as the primary tints. A spectral yellow stimulates both red and green sensations, so does a mixture of red and green lights; hence a certain such mixture will produce the same sensation as does a spectral yellow. In this way the phenomena of colour mixture are explained.

Unfortunately, there are difficulties in accepting this theory. In the first place, there is no histological evidence of the existence of these three units. This objection, taken alone, is not fatal. It is conceivable that anatomical differences exist which are beyond detection with the microscope. But, in addition, there is a vast number of phenomena to be explained besides those of colour mixture, and many of these seem to be directly in opposition to the theory. Dr. Edridge-Green is well known as one who, after prolonged study of the question, was compelled to give up the trichromatic theory. The volume under review summarises the conclusions to which he has come. We can cite only a few of the experimental facts.

In certain cases of defective colour perception the yellow sensation is diminished, and in others lost altogether, although the percipient experiences three definite colour sensations (red, green, and violet). Why do not the red and green make yellow in such cases? If the eye be fatigued with pure spectral yellow light, and be then turned aside to view a spectrum, this will appear to have lost its yellow; and though yellowish-red or yellowish-green will appear less yellow, the terminal red of the spectrum will not be affected. According to the trichromatic theory,

it should be reduced in intensity. Again, the eye may be fatigued with red or green without altering the hue of spectral yellow.

If the image of a white object be suddenly formed on a portion of the retina which was previously occupied by the image of a black object, this image is surrounded by a red border. If, instead of white, a spectral greenish-yellow illumination is used, the border is colourless; if the same greenish-yellow be made up of red and green, it appears red (Bidwell).

Many dichromics have a luminosity curve similar to the normal, although their colour sensations are limited to red and blue at the ends of the spectrum, with a neutral colour in between. This would not be the case if their blindness were due to the absence of one of the sensory units (green).

The theory which Dr. Edridge-Green has developed may be outlined as follows:—

A ray of light impinging on the retina liberates the visual purple from the rods, and a "photograph" is formed.

The ends of the cones are stimulated through the photochemical decomposition of the visual purple by light, and a visual impulse is set up which is conveyed by the optic nerve to the brain.

Instead of analysing this impulse into three components, Dr. Edridge-Green regards it as an integral unit the shape of which depends upon the nature of the light exciting it.

The physicist may be reminded that he himself has already recognised that if the motions in the æther corresponding to white light could be seen, he would not be tempted to speak of them as periodic, though they are capable of being resolved by Fourier's theorem into monochromatic components. The gist of Dr. Edridge-Green's theory is that he deals with the visual impulse as a unit, but asserts (in effect) that if for convenience it is resolved into components, the number of necessary components is usually large. We do not mean that he says this in so many words; but this is, in physical language, what his statements appear to us to imply. His theory is therefore of greater generality than the restricted Young-Helmholtz theory which it supplants.

(2) The card test, which is supplementary to the text-book, consists of twenty-four cards, each containing a large number of irregular, coloured patches or spots. The shapes of these are precisely the same on all the cards, so that the examinee cannot be coached to discriminate by the form alone. These patches are differently coloured on all the cards. Each card contains a number of patches of a selected hue, different from the other patches, arranged in the form of a letter. The examinee is required to declare the letter on each card in turn. The colours are so chosen as to enable the examiner to discriminate between the different kinds of colour blindness.

We have tested them on numerous individuals. Card 8 is particularly useful in the quick detection of weakness in the green. It contains a green C and a brown S. To a normal individual the C is very prominent, while the S is a difficult letter to detect. One examinee who was quite unconscious that he was in any way defective detected the S instantly, while he could not detect the C even when his attention was directed to it.

We have not space to discuss either the book or the card test fully. We congratulate Dr. Edridge-Green on having brought together a wealth of important and interesting material on the physiology of vision.

Hydrographical Surveying.

Hydrographical Surveying: A Description of Means and Methods Employed in Constructing Marine Charts. By the late Rear-Admiral Sir William J. L. Wharton. Fourth edition, revised and enlarged by Admiral Sir Mostyn Field. Pp. xii+570. (London: John Murray, 1920.) Price 30*s.* net.

THE fourth edition of this work on hydrographical surveying differs but slightly from its predecessor, the main text being practically untouched, and the only important changes being the addition of several articles on newer surveying methods and experimental devices which had been introduced in the years immediately preceding the war.

Of these the description of a form of "vacuum tide-gauge," devised by Rear-Admiral H. E. Purey-Cust, a former Hydrographer of the Navy, is perhaps the most interesting, and it will certainly appeal to every nautical surveyor who has had to fight against the difficulties of observing the vertical movements of the tide in situations where direct readings are almost impossible. The addition of a trustworthy self-recorder to the instrument is obviously merely a question of time and experiment, and when it has been perfected this form of tide-gauge will undoubtedly prove an immense boon to nautical surveyors for use in those parts of the world where the ordinary methods of tide reading are impracticable.

It is to be regretted that no mention has been made of the extremely useful and convenient form of current meter known as the "Ekman." This instrument has been used with conspicuous success

by the Admiralty and by the Ministry of Agriculture and Fisheries, and is the standard form of current meter now used by both Departments.

In the new chap. xx. the "Douglas-Schäfer" sounding traveller is described on pp. 434–36, but as this is the official method of obtaining soundings in H.M. surveying vessels, it would have been more suitably placed at the commencement of this chapter than among the miscellaneous collection of methods which are largely experimental.

Several new methods connected with sweeping are now described in the new material of the book, and all have something to be said in their favour; but it is much to be hoped that the results of mine-sweeping, which developed into such a gigantic and well-organised piece of war machinery, will eventually assist in the devising of some form of thoroughly effective sweep for surveying purposes.

This last remark applies similarly to the improvement of surveying devices and methods generally. During the war such enormous progress was made in so many directions affecting scientific developments that many surveying methods must of necessity be entirely, or at least very drastically, altered to bring them up to date. The remarks under the heading "Recent Developments" on p. 470, which deal with this aspect, are, however, distinctly on the conservative side, as it is considered that the scrapping of old systems must be adopted in a very wholesale manner rather than that attempts should be made at their modification to conform to the most modern methods. It is perhaps somewhat difficult to appreciate what an enormous saving of time, and, therefore, of expense and labour, will eventually result from the introduction of many of these methods into hydrographical surveying, but a good example will be found in connection with the use of hydrophones, by the aid of which accurate positions afloat can be obtained in as many hours instead of days or even weeks, which would have formerly been required under the procedure described under the heading "Triangulation by means of Floating Moored Beacons" in the new chap. xxi.

The war, in fact, has shown the necessity in this, as in so many other directions, of revising the text-books which deal with technical subjects, and this is the condition of affairs as regards hydrographical surveying. The work under notice is undoubtedly the standard publication on the subject, and has a well-deserved and world-wide reputation; but it is considered that all such standard works on technical matters, such as that now under discussion, should be prepared and published by the Government Department which is directly concerned, and, therefore, in a position to obtain the fullest information in every possible direction; and lastly, but not least in importance, which is also in a position to keep such an official work always up to date by the periodical publication of supplements.

Forestry, Tree Diseases, and Timber.

(1) *Our National Forests: A Short Popular Account of the Work of the United States Forest Service on the National Forests.* By Dr. Richard H. Douai Boerker. Pp. lxix + 238. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) Price 12*s.* 6*d.* net.

(2) *Commercial Forestry in Britain: Its Decline and Revival.* By E. P. Stebbing. Pp. vi + 186. (London: John Murray, 1919.) Price 6*s.* net.

(3) *National Afforestation.* By A. D. Webster. Pp. 160. (London: T. Fisher Unwin, Ltd., 1919.) Price 6*s.* net.

(4) *Manual of Tree Diseases.* By Dr. W. Howard Rankin. (The Rural Manuals.) Pp. xx + 398. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1918.) Price 12*s.* 6*d.* net.

(5)–(8) *A Map of the World (on Mercator's Projection), Having Special Reference to Forest Regions and the Geographical Distribution of Timber Trees: Timber Map, No. 1. North America: Timber Map, No. 2. South America: Timber Map, No. 3. Europe and Africa: Timber Map, No. 4.* All prepared by J. Hudson Davies. Each on rollers, size 40 in. by 30 in. (Edinburgh: W. and A. K. Johnston, Ltd.; London: Macmillan and Co., Ltd., n.d.) Price 8*s.* net each.

(1) DR. BOERKER'S book is a popular account of the administration and protection of the national forests of the United States, which now constitute about a third of the timber lands in that country. The original forest area was enormous, being estimated at 850,000,000 acres. Nearly half of this has been cleared away, as the land was needed for farms by settlers; but forest fires, felling for timber, and grazing have shared largely in the destruction. To-day the land under timber trees is about 500,000,000 acres. Private ownership entailed disappearance of the forests, as no steps were ever taken to provide for the growth of a second crop of trees upon the ground. State intervention became necessary, and nothing in the political history of the United States is more creditable than the legislation of late years enforcing measures to preserve from fire and to manage

on scientific principles as much of the primeval woodlands as could be rescued from private ownership. Dr. Boerker sketches the history of this great movement.

The first effective step in conservation was the passing of an Act in 1891, which empowered the President to create forest reserves by proclamation. The first to be proclaimed was the Yellowstone Park, and others were added until they amounted to 100,000,000 acres in 1905. In that year the Forest Service was constituted as it now exists, with enlarged powers and increased appropriations from public funds. In 1907 the "forest reserves" were re-named "national forests," to do away with the impression that the timber was not to be used until some future time.

Dr. Boerker gives a list of the national forests, arranged by States, and showing the acreage of each and the headquarters of the Forest Supervisor. The national forests are nearly all in the west, comprising the higher parts of the Rocky Mountains, the Cascades, the Pacific Coast ranges, a part of the coast of Alaska, some of the hills in the Dakotas, eastern Montana, Oklahoma and Arkansas, and small areas in Minnesota, Michigan, and Florida. In March, 1915, there were 162 national forests in all, with a total area of 163,000,000 acres.

Besides the national forests, set aside out of the public lands of the west, there are mountain forests in the east, in the White Mountains and southern Appalachians, which have been gradually acquired by purchase under the Weeks law of 1911. These totalled nearly 2,000,000 acres in 1919. Under the same law the Federal Government co-operates with the States in the protection of forested watersheds, and much has been done to stop the ravages caused by fire.

In 1910 the Forests Products Laboratory was established at Madison (Wisconsin), and this great research institute has since then made signal advances in almost every phase of wood utilisation, to the great gain of the nation in times of peace and during the war. Researches have been made in wood distillation, the testing and seasoning of timber, the pulp and paper industries, tapping pines for turpentine, using wood waste, the production of artificial silk from sawdust, etc. Investigations in the industrial uses of woods have also been carried out. The attention paid to scientific research has been a significant feature of the U.S. Forest Service, as is well shown by the abundant literature on forestry subjects which has been published at Washington during the past ten years.

Dr. Boerker's book is well illustrated, and contains interesting notes on the field work in the national forests, including harvesting seed, modes of planting, diseases and insect attacks, fire protection, the building of roads, trails, and telephone lines, and the supervision of felling operations and grazing. The richness of details makes the book valuable to foresters as well as to general readers.

(2) The two small books by Mr. E. P. Stebbing and Mr. A. D. Webster narrate in a popular manner the achievements and hopes of British forestry, and are in strong contrast to the American treatise just noticed. Both authors fail notably in their historical chapters. Mr. Stebbing tries to compress into a few pages the history of the woodlands and forest policy of Great Britain from the earliest times until 1885. He bases this abstract on Nisbet's disquisition on the subject in his manual "The Forester." The fact is that the history of forestry in Britain cannot be written until it is taken up seriously, and the public records and other documents are studied and made use of.

Mr. Stebbing devotes a chapter to the various Committees and Royal Commissions appointed in the period 1885–1914 to inquire into and deal with forestry in this country. His favourable opinion of the activities of the Development Commissioners will meet with some criticism. This body did useful work from 1909 to 1914 in encouraging forestry education, but made no progress in Great Britain in the "purchase and planting of land found after inquiry suitable for afforestation," one of the main objects for which the Commissioners were appointed. The next chapter treats of the difficulties in timber supplies during the war period. In the remaining chapters Mr. Stebbing is concerned with the future of British forestry, and discusses various matters, such as the requirements of timber by Britain, what afforestation will do for the people, the connection of forestry and agriculture, the acquisition of land for planting by the State, the protection of afforested areas, etc. He is not content with the recommendations of the Reconstruction Committee for the planting of 1,770,000 acres during the next eighty years. However, we must be satisfied, in the present state of public finance, with the immense progress that has been made in the appointment last year of the Forestry Commission with a definite income and an assured programme for the next ten years. At the end of this period the problem can be reconsidered in the light of the experience gained in the meantime.

(3) Mr. Webster's small book begins with a short chapter on the history of British woodlands, which contains too little information to be of any

value. His remaining chapters deal briefly with schemes of afforestation, financial returns, trees for planting, the use of the unemployed in forestry work, the transport of timber, etc. There is nothing novel, and a good deal that is debatable, in his treatment of these subjects.

(4) Dr. Rankin's "Manual of Tree Diseases" is the first American text-book on the subject. Injuries caused by insects or other animals are not included. The first four chapters treat of general diseases, such as many species are liable to, and those affecting seedlings, leaves, stem and branches, and roots are successively dealt with. The main part of the book describes the diseases which attack various groups of trees, beginning with alders and ending with willows. Chapters on tree surgery and on spraying conclude the volume, which is fairly well illustrated. Exact and copious references to the literature of the subject are a useful feature. This manual will be of considerable use in Great Britain, although the diseases occurring here and in America are often different. The account (p. 90) of *Keithia thujina*, a dangerous fungus which has recently appeared in England and Ireland on the valuable forest tree, *Thuya gigantea*, is of considerable interest. In America it is essentially a disease of seedlings, often killing large numbers of those less than four years old. Preliminary experiments indicate that soap-Bordeaux mixture applied every ten days in autumn will greatly reduce the infection.

(5)–(8) These four maps are attractive in appearance, and will prove useful to merchants and teachers, as they show approximately the districts which yield the more important commercial timbers. Their scientific value is impaired by the fact that in a considerable number of species the areas of distribution are incorrect, and the names erroneous or confusing. For example, the small map of Old World larch is incorrect. European larch does not occur, as depicted, in the Pyrenees, Apennines, Serbia, Bulgaria, etc. The Siberian larch is wrongly styled *Larix dahurica*, whereas it is *L. sibirica* which occupies northern Russia and Siberia west of Lake Baikal. *L. leptolepis*, which is restricted to Hondo, in Japan, is represented as existing on Hokkaido, where there is no larch, and in Manchuria and Korea, where the finest *L. dahurica* grows. The small maps might readily convey more information. On the one showing Sequoia and Taxodium it would be easy to add the distribution of important timber trees like Lawson cypress, *Thuya gigantea*, and Western larch.

The author has not tried to explain by notes in the margin the peculiarities of popular nomenclature, such as the use of the term "boxwood" for the Venezuelan *Casearia praecox* (see *Kew Bulletin*, 1914, p. 214); and the application of the word "cedar" to trees so different as Cedrus, Cedrela, and Juniperus. One must acknowledge that the construction of correct maps of distribution is very difficult, as accurate information on some of the tropical woods is difficult to obtain.

Our Bookshelf.

The Natural Wealth of Britain: Its Origin and Exploitation. By S. J. Duly. (The New Teaching Series.) Pp. x+319. (London: Hodder and Stoughton, 1919.) Price 6s. net.

THE general scheme of this little book is decidedly good; it is intended to teach young people how the industries and commerce of Great Britain are conditioned by the geology of our island, both because the geological structure determines the sources from which we derive the materials upon which our national existence depends, and because it has produced the surface contours and configuration that have decided the lines along which our streams of commerce flow to-day. The first portion of the book gives an outline of the main principles of structural geology; then follows a section on the fundamental industries based on geological structure; and the third part deals with the geographical and geological relations of some of our most important industrial districts.

In view of the evident educational value of the plan of the book, it is all the more to be regretted that its execution is so defective. The first requisite in a text-book for young people is accuracy, and in this respect the author fails lamentably. A few random examples will illustrate the slipshod nature of the work. Thus the author, in describing granite, states that it consists of three constituents—quartz, felspar, and "the third constituent of granite comprises all the various metallic compounds." Again, a few pages further on, he tells his readers that "sapphire, ruby, aquamarine, and topaz are crystalline forms of clay."

The chapters devoted to mining are by far the worst, and it is not too much to say that there is scarcely a page that is not disfigured by some inaccuracy of more or less importance. It is impossible to imagine anyone with any real knowledge of mining writing that "the *foot-wall* beneath the coal seam is cut away . . . by *pick-axe*" (the italics are the reviewer's), or that pillars of coal "are sometimes left to support the roof." Were it not for the numerous inaccuracies of the kind indicated, this would be a most useful text-book for the general reader, but, as it is, it is greatly to be feared that he is as likely to pick up totally false impressions as to obtain useful information from its pages.

H. L.

Animal Heroes: Being the Histories of a Cat, a Dog, a Pigeon, a Lynx, two Wolves, and a Reindeer. By Ernest Thompson Seton. Fourth impression. Pp. 363. (London: Constable and Co., Ltd., 1920.) Price 8*s.* 6*d.* net.

THIS lively and generously illustrated book begins with the story of four of the lives of a "Royal Analostan" cat—we were a little afraid that there were to be nine—which, in virtue of considerable worldly wisdom, got on well against heavy odds. "But in spite of her prosperity, her social position, her royal name and fake pedigree, the greatest pleasure in her life is to slip out and go a-slumming in the gloaming, for now, as in her previous lives, she is at heart, and likely to be, nothing but a dirty little Slum Cat." The second story tells of the ability of a homing pigeon and of its successful education. "The hardest of all work is over the sea, for there is no chance of aid from landmarks; and the hardest of all times at sea is in fog, for then even the sun is blotted out and there is nothing whatever for guidance. With memory, sight, and hearing unavailable, the Homer has one thing left, and herein is his great strength, the inborn sense of direction. There is only one thing that can destroy this, and that is *fear*, hence the necessity of a stout little heart between these noble wings." This is a fair sample of the more reflective passages in the book, and it is too easy-going. There is a stronger note in the two descriptive studies of wolves, for Mr. Thompson Seton excels in proportion to the wildness of the scenery and of the *dramatis personae*. The other subjects are "The Boy and the Lynx," "The History of a Jack-Rabbit," "The Story of a Bull-Terrier," and "The White Reindeer." The author is an artist in reading the man into the beast—a great art, but a dangerous one; and we are afraid that some of the book is in the danger zone. But those who recoil from "apsychic" biology will probably agree that Mr. Thompson Seton's anthropomorphic faults lean to virtue's side.

The Year-book of the Scientific and Learned Societies of Great Britain and Ireland. Thirty-sixth Annual Issue. Pp. viii + 336. (London: C. Griffin and Co., Ltd., 1919.) Price 12*s.* 6*d.* net.

As is well known, this invaluable year-book gives official particulars and records of work not only of scientific societies in the British Isles, but also of such institutions as the Imperial Institute, Meteorological Office, National Physical Laboratory, Rothamsted Experimental Station, etc. Titles are given of papers read during the session 1918–19, and twenty-six new societies have been added to the comprehensive list of those surveyed in this volume. The work is one which we continually consult, and it is an essential volume for the reference library of every newspaper, institution, college, or club which desires to provide its staff or members with accurate particulars of the officers and activities of scientific organisations throughout the kingdom.

Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Weather Forecasts and Meteorology.

THE experience gained during the last few years in aerial navigation has shown, among other things, that weather forecasts, in these latitudes at any rate, are trustworthy only for a few hours in advance, and not always that.

If weather forecasting were at all accurate for a day or two ahead, it would be possible to make a correct weather-chart for to-morrow from the information received to-day. This has never yet been done, and it seems unlikely that it ever can be done, for the simple reason that in latitudes higher than 30° or thereabouts the conditions of the flow of the air are those of the permanent instability which characterises a stream exposed to the influence of surface friction at a velocity greater than that compatible with lamellar flow.

The unstable motion referred to consists of eddying motion superposed on a general drift, the eddies themselves being of all sizes and in all stages of growth and decay—some showing actual rotation, others being merely distinguishable by differences of velocity and direction. Eddies, when formed, have a certain individual life, generally of not many hours' duration, though in some cases there may be maintaining causes which will prolong their existence for days. The deviations of their courses (*i.e.* the path of their centres) from the average direction of the stream depend chiefly on the state and intensity of the other eddies in the neighbourhood, and, within wide limits, must be treated as a matter of pure chance.

Let anyone watch the motes of dust in the air illuminated by a beam of sunlight passing through a slit. They may all, on the whole, be drifting in some one direction, but combined with the general drift there will be irregular eddying motions, some quick, some slow, but deviating largely from the average for the whole. Much the same sort of thing on a large scale takes place in the atmosphere, and a weather forecast professes to determine from the motion over a certain area and at a certain time, together with the then existing variations, what the future motions will be.

For a time so short that the eddying motions preserve their respective characters this can be done, but not for longer periods, the causes which alter existing eddies and develop new ones being incalculable.

If the weather prophet makes no observations whatever, but is content to say that "to-morrow will be like to-day," he will be right rather more than sixty times out of a hundred. With all the information which can be obtained, by telegraph or otherwise, he may add 10 or 15 per cent. to his correct predictions for twenty-four hours ahead.

The Meteorological Office, I believe, claims rather a better average than this, but its forecasts are often so vague (*e.g.* "Wind moderate, strong to a gale at times in places. Fair, but with some cloud and rain. Temperature moderate") that almost any sort of weather might be said to fulfil the prediction.

The proper test of the value of forecasts for a day in advance would be to prepare a chart for that day and to publish it side by side with one formed from

the actual data when they come to hand. A comparison of the two would soon show that weather prediction for more than a few hours ahead was impossible in present conditions.

While, however, long forecasts are, for the most part, mere untrustworthy guesswork, there are many meteorological subjects now neglected which might be investigated with success, but concerning which at present practically nothing is known. Such are the origin of the variation of electric potential in the air, the origin of thunderstorms and lightning, the coalescence or non-coalescence of cloud particles, the origin of hail and the causes which determine the shape and size of snow crystals or the volume of raindrops, the forms of clouds, and many others. Also there are more general questions still to be answered concerning trade winds and the circulation in equatorial regions. All investigations on these subjects should include the proper scales of comparison and attempts to produce corresponding phenomena on a small scale. A. MALLOCK.

New University Club, June 28.

The Rate of Ascent of Pilot-Balloons.

IN NATURE for June 17 Dr. van Bemmelen directs attention to the excess rate of rising which pilot-balloons often show in the first few minutes of their ascent, and refers to two explanations of this phenomenon which have been put forward. These are that the rapid rising may be due (1) to turbulence in the lower layers of air or (2) to the tendency of balloons to be drawn into rising columns of air and thus to partake of their upward motion. The curves reproduced by Dr. van Bemmelen, which indicate the relation between rising velocity and height under different conditions, are of great interest, and show that the effect is not found when working on a small island in the Java Sea.

As double-theodolite observations over a sea exposure are not numerous, it may be of interest to refer to

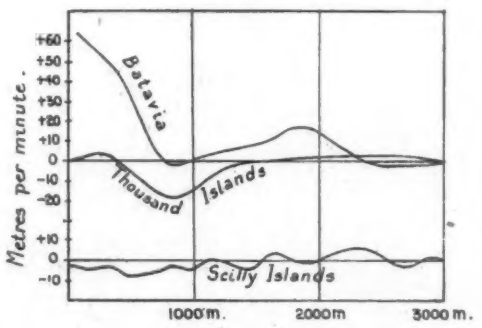

FIG. 1.

the results obtained by Capt. C. J. P. Cave and the present writer in some ascents made from the Scilly Islands during two winter months, November and December, some years ago. Particulars have recently been published by the Meteorological Office in Geophysical Memoir No. 14. The mean rate of ascent of the balloons used was found to be 160 metres per minute. Mean departures from this value for each minute of the ascent measured from the start are shown in Fig. 1. Dr. van Bemmelen's diagrams for the Thousand Islands and Batavia (0–3 p.m.) are also reproduced for comparison. It will be seen at once that the rate of ascent at Scilly, like that at the Thousand Islands, shows no excess above the normal in the first kilometre of height; if anything, the effect is slightly the other way.

Ascents in the Scilly Islands are of particular interest in this connection. The area of the islands is so small that no convection effects due to solar heating would be expected, at any rate in the winter. On the other hand, the group contains a great number of small islands of a rocky and hilly nature, and these are spread over an area of some ten miles by five. They might naturally be expected to produce some turbulence in the air passing over them, and such turbulence is, in fact, shown by the records of the pressure-tube anemometer on St. Mary's, the largest of the islands. If the excess rate of rising so frequently noticed in the first kilometre over land is due to turbulence, as suggested by Wenger, we should expect to find it in the Scilly ascents; if it is due to convection currents caused by solar heating, we should not expect to find it. The evidence afforded by this example seems clear. J. S. DINES.

66 Sydney Street, S.W.3, June 22.

Diamagnetism and the Structure of the Hydrogen Molecule.

IN a letter to NATURE of June 24 (p. 516) Dr. J. R. Ashworth has pointed out a possible origin of the diamagnetism of hydrogen by assuming oscillations or rotations of Bohr's paramagnetic hydrogen atom or molecule. Granted that such motions tend towards a diamagnetic effect, it is important to examine the plausibility of such a view in the light of recent experimental data. We know that:

(1) The specific susceptibility (χ_m) of *gaseous hydrogen at* 16° *C.* is $-19{\cdot}8(2) \times 10^{-7} \pm 0{\cdot}15 \times 10^{-7}$, with a mean error of 0·76 per cent. (Take Soné, Science Reports, Tôhoku, vol. viii., p. 115, 1919). *No variation of this, within the limits of experiment, could be detected over a pressure range of* 1 *to* 68 *atmospheres.*

(2) The value of χ_m for *liquid hydrogen at a temperature less than* $-253°$ *C.* is -27×10^{-7} (Onnes and Perrier, Proc. Amsterdam Acad., vol. xiv., p. 121, 1911).

(3) The value of χ_m for atomic hydrogen in various types of chemical combination, as deduced from the additive law of atomic diamagnetism for the hydrocarbons, is $-30{\cdot}5 \times 10^{-7}$ (Pascal, *Ann. de Chim. et de Phys.*, vol. xix., p. 5, 1910).

(4) There is no definite evidence that the diamagnetic susceptibility varies simply with temperature over a range $-180°$ C. to 20° C. Such small variations as do occur never change the sign of χ (except in the case of tin), and are attributable to changes of molecular grouping, *e.g.* crystallisation or aggregation (Ishiwara, Science Reports, Tôhoku, vol. iii., p. 303, 1914; A. E. Oxley, Phil. Trans. Roy. Soc., vol. ccxiv., A, p. 109, 1914).

(5) The theory of molecular rotation developed by Honda and Okubo (Science Reports, Tôhoku, vol. vii., p. 141, 1918), which is similar to that proposed by Dr. Ashworth, accounts for the diamagnetism of hydrogen and helium only if we suppose molecular rotations of angular velocity $6{\cdot}54 \times 10^{14}$ sec^{-1} and $3{\cdot}80 \times 10^{15}$ sec^{-1} respectively. In the case of the paramagnetic oxygen molecule it is necessary to suppose that *there is no rotation whatsoever* in order to obtain

the hyperbolic susceptibility-temperature relationship for gaseous oxygen (Také Soné, *loc. cit.*).

(6) If the diamagnetism of hydrogen is attributed to thermal oscillations or rotations, we might expect that χ_H for the gas at 16° C. would be greater than χ_H for liquid hydrogen at −253° C. Precisely the reverse holds, according to the above data, and there is certainly no indication that at low temperature χ_H is tending to change sign.

A variation of χ_H from $-19{\cdot}8\times10^{-7}$ to -27×10^{-7} for a temperature interval of 16° C. to −253° C., together with the fact that χ_H in different types of organic compounds is constant and equal to $-30{\cdot}5\times10^{-7}$, points to the conclusion that thermal oscillations and rotations have little to do with the *origin* of diamagnetism in molecular hydrogen, and that the Bohr hydrogen molecule will not account for it.

The present writer's view is that the free hydrogen atom is probably paramagnetic, but the structure of the hydrogen molecule must be such that by compensation it is, as a whole, diamagnetic. A model of the hydrogen molecule which satisfies these conditions was suggested in NATURE of May 13, 1920. In this model the individuality of the hydrogen atom is preserved, and this may have some bearing on the origin of the primary and secondary hydrogen spectra.

A. E. OXLEY.

The British Cotton Industry Research Association, 108 Deansgate, Manchester, June 28.

University Stipends and Pensions.

ALL university teachers will thank you for the leading article in NATURE of June 17 pointing out the injustice done to them and to university education by the exclusion of such teachers from the provisions of the School Teachers (Superannuation) Act, 1918. On one point, however, the article is misleading. It is stated that "what complicates matters is the fact that there exists a contributory pension scheme in the universities—the federated superannuation scheme—which is thought by some to be superior to the Teachers Act in certain respects." It should be made quite clear, however, that the governing bodies of university colleges are at liberty to adopt the federated scheme or not, and that the governing bodies of some colleges have refused to adopt it, with the result that the staffs of these colleges have no prospect of any pensions whatever. The position in the University of London is, therefore, even more anomalous than was suggested, since some schools come within the provisions of the Act, some have contributory pension schemes, and some have none. The Northampton Polytechnic Institute and the Imperial College of Science and Technology have each an engineering department the courses in which enable their students to take the B.Sc. degree of London University as internal students of the University. The lecturers of each sit side by side on the Faculty of Engineering and on the various Boards of Studies of the University. The first-named institution is included in the Teachers Act, but the last-named is excluded. Lecturers at the former retire at the age of sixty with a non-contributory Government pension, whilst their *confrères* at the Imperial College may work as long as they are able with no prospect of any pension whatever.

G. W. O. H.

THERE is nothing in "G. W. O. H.'s" letter to support his statement that the article is misleading. It is true that no university or university college is compelled to join the federated scheme, but it is equally true that such a scheme exists, and that most universities and university colleges have adopted it. The additional particulars which "G. W. O. H." gives were known to us, but obviously in a short article every variety of illustration could not be included.—ED. NATURE.

The Separation of the Isotopes of Chlorine.

IN agreement with Prof. Soddy, I find myself unable to understand how it is possible to separate isotopes by the method suggested by Mr. D. L. Chapman in NATURE of June 17. Nevertheless, a certain paradox has been brought to light in connection with Nernst's theorem the solution of which is not without interest.

The paradox to which I refer is this: Consider the equilibrium in the gaseous reaction $Cl_2+Cl'_2 \rightleftharpoons 2ClCl'$. If the gases behave as perfect gases, and if Cl and Cl′ are identical or differ only very slightly, then it is easy to show by probability considerations that the equilibrium must be given by

$$\frac{[ClCl']^2}{[Cl_2][Cl'_2]}=K=4.$$

From this it follows that to convert a gram-molecule of Cl_2 *plus* a gram-molecule of Cl'_2 into two gram-molecules of ClCl′ at the same temperature and pressure, α will require an amount of available energy equal to $-RT\log 4$.

Now if the chemical and physical properties of the isotopes are truly identical, then from this and the necessary equality of the vapour pressures it is readily shown that to convert a gram-molecule of solid Cl_2 *plus* a gram-molecule of solid Cl'_2 into two gram-molecules of solid ClCl′ also requires $-RT\log 4$ of available energy. Therefore the difference in the entropies of the two sets of solids is $R\log 4$, which, being independent of the temperature, must exist at the absolute zero.

It is, however, unjustifiable to say that this contradicts Nernst's theorem, and to deduce from this theorem that K for the gaseous reaction must be 1 in order to make the change in the entropy zero. For if there is a true identity, then this implies that there are no forces to guide the atoms into any particular configuration, so that even down to the zero of temperature no true reaction is possible, and what occurs is really of the nature of mixing. That a difference of entropy occurs on mixing, even at the zero, is necessary, and in no way contradicts Nernst's theorem; in fact, the case of mixtures is explicitly excluded by Nernst.

If, on the other hand, there is a real, but small, difference in the two isotopes, then, as before, K will very nearly equal 4. Now, in order to obtain the difference in the entropies between the solids near the zero of temperature, let us carry out the cycle described by Mr. Chapman, but in the neighbourhood of the zero. Then, in spite of the fact that the isotopes differ very little, it is impossible to say that the vapour pressures remain equal. Thus it is impossible, so long as there is any difference at all between the isotopes, to argue that because $K=4$ for the gaseous reaction there must be a finite change in entropy at the absolute zero.

ANGUS F. CORE.

The University, Manchester, July 4.

The Island of Stone Statues.[1]

By SIR EVERARD IM THURN, K.C.M.G., K.B.E.

MRS. ROUTLEDGE'S account deals with her most adventurous yachting cruise, with her husband, to Easter Island, the easternmost—*i.e.* the nearest to the American coast—of that great archipelago of innumerable islands which begins off the Australian coast and ends at this islet of stone images. A considerable number of the pages of the book are occupied by a vivid and rather unusually interesting travellers' story of places visited on the outward and homeward voyages, Patagonia and the islands of Juan Fernandez and Pitcairn among others; but it is to the much fuller account of Easter Island itself, occupying one hundred and seventy-six pages of the middle of the book, that we turn most eagerly.

The mystery which surrounds the history of Easter Island, with its great statues and its unique, and perhaps for ever indecipherable, script, unparalleled elsewhere, has from time to time long attracted the attention, though very rarely the visits, of ethnologists; but in the absence of exact data the mystery has hitherto never been even approximately solved.

Mr. and Mrs. Routledge, in search of new adventure, sailed in their own small yacht, the *Mana*, to the island, spent some fifteen months there (Mr. Routledge was away from the island during a considerable part of the time), and have now given us a somewhat full account of their experiences there. The story, if far from completely satisfying, at least supplies a very great deal of material for home-staying ethnologists to study. Moreover, Mrs. Routledge holds out hopes of "another volume in prospect, with descriptions and dimensions of some two hundred and sixty burial places in the island, and thousands of measurements of statues, and other really absorbing matter." It is greatly to be hoped that this further instalment of exact data

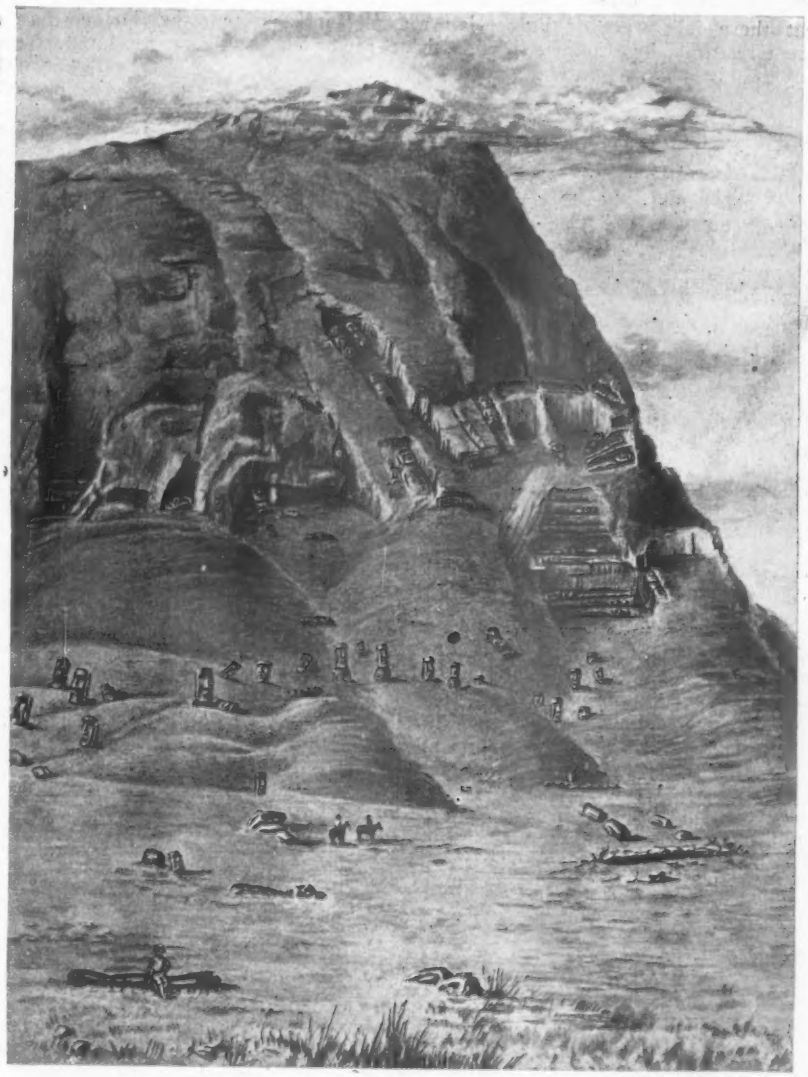

FIG. 1.—Exterior of Rano Raraku. Eastern portion of southern aspect. Diagrammatic sketch showing position of statues. From "The Mystery of Easter Island."

[1] "The Mystery of Easter Island: The Story of an Expedition." By Mrs. Scoresby Routledge. Pp. xxi+401. (London: Sifton, Praed, and Co., Ltd., n.d.) Price 31s. 6d. net.

will be published before the great interest which has been aroused by the present foretaste has evaporated.

The most interesting points brought out in the present book are those which serve to throw partial light on the great stone statues which are so abundant in the island, and, in connection with these, on the origin of the Easter Island folk. It has hitherto generally been assumed that these folk were of Polynesian race. But recent research, by Prof. Keith and others, seems to show that, in Easter Island, as in so many of the South Sea Islands, several races with other than Polynesian culture have from time to time invaded this remote and isolated islet. Mr. Henry Balfour (in *Folklore* for December, 1917) has suggested (modestly he disclaims to have done more) some of the main results to which Mr. and Mrs. Routledge's experiences seem to point, and chiefly to the probability that at some long-distant time a strong wave of Melanesian influence reached Easter Island. Certain points of curiously strong resemblance between Easter Island arts and customs and those found in certain of the Solomon Islands serve to illustrate this.

FIG. 2.—A finished Hat at Ahu Hanga O Ornu; others in the distance. From "The Mystery of Easter Island."

Without throwing any doubt on this suggestion, tentatively put forward by Mr. and Mrs. Routledge, with the strong support of Mr. Balfour and others, I again venture to put forward the view that, while Easter Island culture is doubtless of very mixed origin, Polynesian and Melanesian elements being most strongly represented, there were probably also other elements—*e.g.* some influence, possibly slight, and only very occasional, from the not far distant American shore lying to the eastward. For instance, the script (on wooden plaques), the rock-carvings, the featherwork, and the very peculiar form of tapa (bark cloth) which was used in Easter Island, all seem to me to suggest an Eastern, rather than a Western, origin.

One other suggestion may here be put forward as a contribution to the consideration of the Easter Island mystery. Mrs. Routledge writes of the well-known "top-pieces" which are, or were, superimposed on the statues as "hats"; and Mr. Balfour suggests that these were very probably meant to represent not hats, but hair, and in the number of *Folklore* above quoted he works this out in very ingenious detail. I venture to suggest a slight amendment to Mr. Balfour's proposition—*i.e.* that the stone cap-pieces in question were meant to represent not actual growing human hair, but wigs, such as those which were, and still to some extent are, commonly used by Fijians—though whether by those of Polynesian or Melanesian origin I cannot now say. It would be interesting to know how far such wigs were used in other parts of the Pacific.

It is satisfactory to know that a second edition of Mrs. Routledge's book is already in course of preparation, and all ethnologists must hope that the full scientific data will also soon be published.

The Blue Sky and the Optical Properties of Air.[1]

By the RIGHT HON. LORD RAYLEIGH, F.R.S.

Scattering by Small Particles. Polarisation.

THE subject chosen for this evening is one which specially interested my father throughout his career. I shall try to put before you some of his conclusions, and then pass on to more recent developments, in which I have myself had a share.

Let us begin with one of his experiments which illustrates the accepted theory of the blue sky. We have here a glass tank containing a dilute solution of sodium thiosulphate. A condensed beam from the electric arc traverses it and then falls on a white screen, where it shows the usual white colour. I now add a small quantity of acid, which decomposes the solution with slow precipitation of very finely divided particles of sulphur. As soon as this precipitation begins you see that light is scattered—that is to say, it is diverted to every side out of the original direction of propagation. Moreover, you will observe that the

[1] Discourse delivered at the Royal Institution on Friday, May 7, 1920.

scattered light is blue. The transmitted beam is robbed of its bluer constituents, and tends to become yellower, as you may see on the screen.

The light scattered laterally is to be compared to the blue sky; the yellow transmitted light to the direct light of the setting sun when it has traversed a great thickness of air.

As the precipitation goes on, the transmitted light becomes orange, and even red. But the particles of sulphur eventually get bigger, and then give a less pure blue in the lateral direction. We shall have more than enough to occupy us if we confine our attention to the earlier stages, when the particles are small compared with the waves of light.

A very important property of the scattered light is its polarisation. The vibrations of the scattered light as you have seen it, viewed laterally in the horizontal plane, are almost wholly up and down. No light is emitted which vibrates in the horizontal plane. It is easy for individual observers to verify this with a Nicol's prism held to the eye, but this direct method unfortunately does not lend itself to public demonstration.

We may, however, use polarised light to begin with, and you can then observe that if the polarising Nicol is set so as to transmit up and down vibrations, these are abundantly scattered towards you by the small particles. As I turn the polarising Nicol through a right angle, you will see that the light scattered towards you is extinguished.

The polarisation of light scattered by the sulphur particles is one of the most conclusive reasons for considering it to be an analogue of the blue light of the sky, for the latter shows a polarisation of exactly the same kind when examined at right angles to the sun.

A cloud of small particles of any kind is capable of producing these effects, the essential condition being that the individual particles should be of small dimensions compared with the wave-length of light, so that at a given moment the vibration at a given particle may be regarded as having a definite phase. In this case it was shown by my father that the shorter (blue) waves are of necessity more scattered than the longer ones (red); thus the scattered light is bluer than the original. This conclusion can be justified in detail whether we adopt the elastic solid theory, or the electromagnetic theory of the nature of light, but it is also deducible from the general theory of dimensions, without entering upon any details of the nature of light beyond its characterisation by the wave-length.

An alternative theory which still sometimes shows its head attributes the colour of the sky to a blueness of the air, regarded as an absorptive medium. Such blueness is referred to the presence of ozone, and appeal is made to the undoubted fact that a sufficiently thick layer of ozone shows a blue colour by absorption. This theory gives no account of why the sky light is polarised, or indeed of why there is any light in the clear sky at all. Further, its fundamental postulate that the air is blue by transmission is contrary to observation. The setting sun is seen through a greater thickness of air than the midday sun. According to the theory under discussion, the setting sun ought to be the bluer of the two, which everyone knows it is not. No doubt the presence of ozone tends to make the air blue by transmission. But this effect is more than compensated by the lateral leakage (scattering) of blue light from the beam, which makes the transmitted light yellow.

Dusty Air and Pure Air.

If it be conceded that the blue sky is due to scattering by small particles, we are confronted with the question: Of what nature are these particles? At the time of my father's early investigations (1871) this was left open, though they were regarded as extraneous to the air itself. In 1899 he returned to the subject, and considered the matter from the point of view of what was lost by the original beam by lateral leakage (scattering), which simulates the effect of absorption. He then found that the air itself, regarded as an assemblage of small particles (molecules of oxygen and nitrogen), would have an apparent absorbing power not much less than that actually deduced by observations of the sun at different altitudes. The inference was that the air itself was capable of accounting for much, if not all, of the scattering which is observed in the blue sky; in fact, that the molecules of air are the small particles in question.

When a beam of sunlight enters a room through a small aperture in the shutter, its course is readily traced by the brightly illuminated motes in the air. Prof. Tyndall, working in this institution, devoted much attention to the nature of these motes, and the methods by which they may be got rid of. His results may be consulted in his fascinating essay on "Floating Matter." One way of getting rid of the motes is to filter the air through cotton-wool. We have here one of Tyndall's own experimental tubes. The electric beam passes axially along it, and is concentrated to a focus about the middle of its length. Its track is conspicuous. If now we displace the air originally in the tube by filtered air, you see that the cone of light fades into invisibility.

Another of Tyndall's experiments was merely to place a spirit lamp or Bunsen burner under the beam. Since most of the dust particles are combustible, the gases rising from the flame are free from them. As you now see, dark rifts appear in the beam where the uprising stream of dust-free gases traverses it.

Tyndall, on the strength of these experiments, stated without qualification that dust-free air does not scatter light, but my father's views and theory lead clearly to the conclusion that it does. But when I asked him what he thought about the feasibility of detecting it by a laboratory experiment, he was not very sanguine of success. It seemed worth while, however, to make the attempt, and I came to the conclusion that the difficulty was not

so much in the faintness of the effect to be looked for as in the avoidance of stray light which came into competition with it. The essential thing is to get a perfectly black background against which the beam (viewed transversely) can be observed. We cannot get this with a vessel like Tyndall's tube just used. It is necessary to have what may be called a black cave, and to view the beam as it crosses in front of the mouth of the cave, the latter forming the background. If the cave is deep enough, there is no limit to the blackness attainable. The great sensitiveness of the well-rested eye, or the photographic plate, can then be brought to bear, and the track of the beam can be well seen, however carefully the dust is removed.

Some persons have been inclined to question whether the dust is removed completely in these experiments. As a matter of fact, this is not where the difficulty lies at all. Dust so fine as to be very difficult of filtration is an arm-chair conception, not encountered in practical experimenting. An enormous multiplication of the length and tightness of the cotton-wool filter makes no difference at all, a filter of modest dimensions doing all there is to do.

The dust particles which are originally present in the air, near the ground or in a room, are large, being in some cases individually visible to the naked eye; thus they do not fulfil the condition for scattering a preponderance of blue light. The molecules of air are, of course, amply small enough, and the band of light seen stretching across the mouth of the dark cave is, to my eyes at least, of a full blue colour. In exhibiting the effect to individual friends (and unfortunately it is not bright enough to be shown to an audience), I have been surprised and somewhat disconcerted to find that they do not all see it blue as I do, but some, for example, describe it as lavender. This is undoubtedly due to a peculiarity of colour-vision where faint lights are concerned. The ultimate test is the spectroscope. Photographs of the scattered light taken with this instrument clearly show that the maximum of intensity is shifted towards the blue, as compared with the original exciting light.

Polarisation of Light Scattered by Pure Air.

A very important point to examine in connection with the scattered light is its state of polarisation. Visual examination with a Nicol's prism soon showed that the polarisation was very nearly complete. For closer examination I had recourse to photography. It may perhaps be thought an easier and more effective plan to look at a phenomenon than to photograph it, and no doubt it is so in many cases: not, however, where the light is very faint, but admits of long exposure. It has long been recognised that photographs of the nebulæ will show much more than can be detected visually by the keenest and most discriminating eye. In this work on the scattering of light, I have found it positively less trouble to take a photograph than to make a visual observation, even when the latter was feasible. The time required to rest the eye in darkness and the effort of attention required in observing a faint effect cost the experimenter more than the exposure and development of a plate.

When the scattered beam in pure air is photographed, with a double image prism of Iceland spar mounted over the photographic lens, it is found that the polarisation is nearly complete, but not absolutely so. However carefully the instrumental adjustments are made and the air filtered, I have found that there is a slight residual polarisation indicating vibrations parallel to the direction of the original beam. The intensity of this residual polarisation, in what may be called for convenience the wrong direction, is about 4 per cent. of the whole. Now, as the theory shows, there are two causes to which failure of complete polarisation may be attributed. One, which we may dismiss in this case, is that the particles are not small enough. Another is that they are not spherical—that is to say, it is not a matter of indifference which way they are presented to the primary beam. The latter alternative may be illustrated by considering an extreme case—namely, what we may call a needle-like molecule, capable of vibrating only in one direction fixed within it. Evidently such a molecule when obliquely situated will have a component vibration parallel to the direction of the incident light.

From the experimental fact that there is such a component we may infer that the molecules of air are not in the optical sense spherical. Experiments on various gases have shown a characteristic departure from complete polarisation, different for each gas. Much effort has been spent on determining the exact amount for each, and it is hoped that the numbers obtained will form valuable material in the future for investigating the structure of atoms and molecules.

Polarisation of the Night Sky.

We have seen that the polarisation of the daylight sky is one of the most conclusive proofs that its light is due to scattering by small particles. What of the sky at night? Some of you will perhaps be inclined to reply that the sky at night is dark, and that the question whether its light is polarised does not arise. It is, however, by no means the case that the sky on a clear night is absolutely dark, as anyone may readily prove by holding his hand with outstretched fingers against the sky. The fingers will appear dark against the sky as a luminous background.

The light is no doubt very faint, but I thought it would be practicable to test whether it was appreciably polarised or not. For this purpose what is called a Savart polariscope was used. Time will not allow us to consider the rather complex theory of this apparatus; it must suffice to say that if the light which falls upon it contains even a small part which is polarised, bands alternately bright and dark are produced, which further show colour due to the composite nature

of white light. These bands are clearest when the incident light is completely polarised, as you now see them projected on the screen. But they can still be seen when the polarisation is but slight. I will illustrate this by removing the polarising Nicol which I have been using, and substituting a single glass plate, through which the incident light passes. If I incline this plate so as to polarise a small fraction of the light, you see the bands, faint but sufficiently distinct. In examining the light of the night sky, a photographic plate is substituted for the paper screen I have been using to-night, and the apparatus is designed for the utmost economy of light. With two hours' exposure a definite image of the sky was obtained, with the stars superposed upon it. The Savart bands could be seen, but they were very faint compared with what would have been observed with an equally good image of the daylight sky. The part of the sky examined was near the pole, and therefore nearly at right angles to the sun. If, as seemed possible, the night sky derived its light from an attenuated atmosphere so high as to be outside the earth's shadow, we should expect it to show the same polarisation as the day sky. Since it does not do so, we must attribute the light at night to some different origin.

I was fortunate in being able to interest Prof. Hale in this matter while he was on a visit to England, and as a result Mr. Babcock repeated the observations in a modified form at the Mount Wilson Observatory in California. The traces of polarisation which he obtained in that clear atmosphere were even less than what I got in England.

Ozone, and the Limit of the Solar Spectrum.

Although, as we have seen, the idea that the blue colour of the sky is due to any action of ozone cannot be admitted, yet there are points of great optical interest connected with the presence of this gas in the atmosphere. We may now turn to the consideration of some of these.

It is of course well known that when the solar spectrum is formed by a prism of quartz or by a grating, the spectrum can be observed to extend beyond its visible limit in the violet into the region called ultra-violet. When, however, we examine the spectrum of an electric arc (and for this purpose an iron arc is particularly suitable), the extension is observed to be very much greater than in the solar spectrum. This is not because the sun does not emit any rays of the kind in question, but because the earth's atmosphere will not allow them to pass through so as to reach us at the earth's surface. There are many reasons for feeling sure that this is the true explanation, but one of the simplest will here suffice. When the sun is near the horizon, so that the rays pass obliquely through the earth's atmosphere, and consequently have to traverse a thicker absorbing layer, the extent of the ultra-violet spectrum is found to be even less than when the sun is high and less air is traversed by the rays. This sufficiently proves the point.

It has long been suspected that ozone in the atmosphere is the effective cause of this absorption of the ultra-violet rays. The most important constituents of air, oxygen, and nitrogen do not appreciably absorb at the point where the solar spectrum ends, nor do the constituents of secondary importance, carbonic acid, water-vapour, and argon. We must therefore look to some rare constituent of air which is very opaque to this region of the spectrum. Ozone possesses this opacity, as I shall now show you. So far as I know it has not been attempted to show this before to an audience, but I think you will be able to see it without difficulty. As a source of light an iron arc is used, and the lenses and prism employed in forming the spectrum are of quartz. I allow the spectrum to fall on a piece of paper, and you see the usual succession of colours, red, yellow, green, blue, and violet, forming a comparatively narrow rainbow-like band. Beyond the violet all appears dark, the eye being insensitive to the ultra-violet rays. If now I substitute for the paper a screen of barium platinocyanide[2] (of the kind used in X-ray work), we see an immense extension of the spectrum beyond the violet. The screen has the property of transforming the ultra-violet rays, which the eye cannot detect, into green rays which are readily visible. Thus beyond the violet region we see green, which is, of course, in no way to be confused with the original green which was present in the source, and appears in its normal position in the spectrum, on the other side of the blue-violet. I interpose a thin sheet of ordinary glass, and the greater part of this extension of the spectrum which we get on the fluorescent screen disappears. What I want specially to show you, however, is that a thin layer of ozone, much too thin to have any perceptible colour, will have the same effect. There is a glass tube, about 6 in. long and ¾ in. in diameter, situated between the quartz lantern condenser and the slit, when the beam is parallel, and the walls of the tube are projected as two thin transverse lines on the slit, dividing the spectrum into thin horizontal strips, one over the other. The light constituting the middle strip has traversed the tube, but the light constituting the upper and lower strip has traversed the open air above and below the tube. A stream of oxygen passes through a Siemens ozone generator and enters the middle of the observation tube, streaming out at the two ends. While the ozone generator is not excited, the middle strip of the spectrum is similar to the comparison strips above and below. If the induction coil is turned on so that ozone passes into the tube, you see that in a few seconds the greater part of the ultra-violet spectrum fades out from the middle strip, which contrasts sharply with the upper and lower ones. When the coil is turned off, the ozone is rapidly blown out by unozonised oxygen, and the original state of things restored.

It must be remembered that the ozone used in this experiment is extremely dilute, probably only a fraction of 1 per cent. of the oxygen in the tube.

[2] Kindly lent by Messrs. Watson.

Yet it interposes an impassable obstacle to the ultra-violet rays, at least to those of shorter wave-length than about 2900 angstroms. It cuts off the iron spectrum at about the same point where the solar spectrum ends. Speaking roughly and generally, it may be said that glass is somewhat more opaque than ozone—*i.e.* that with diminishing wave-length the limit of transmission is reached somewhat sooner. To make a statement of this kind quite definite the thickness must of course be specified.

Sir William Huggins devoted a great deal of attention to the spectra of the sun and stars in the extreme ultra-violet region, using for the purpose a reflecting telescope, and prisms and lenses made of quartz or Iceland spar. In this way the absorption of a glass objective was avoided. He noticed in 1890 that the spectrum of Sirius showed a number of bands near the extreme limit of atmospheric transmission, the bands tailing off into complete absorption.

These bands were observed and discussed by other authors, but no definite conclusion was reached as to their origin until 1917, when the matter was taken up by my colleague, Prof. Fowler, and myself. Our interest was stimulated by an excellent photograph of the bands, taken at Edinburgh Observatory under Prof. Sampson's direction, which I show on the screen. We found that the same bands were present in the solar spectrum. It may seem strange that this had not been observed long ago, considering how closely the solar spectrum has been scrutinised for more than a generation. As a matter of fact this is one of the cases where a powerful instrument is a positive disadvantage. The bands are diffuse, and under high dispersion they are unrecognisable. In any case, they are less conspicuous than in the spectrum of Sirius, because in the sun numerous metallic lines are superposed upon them and distract the eye.

Now the position and general aspect of these bands suggested that they were connected with the absorption which terminates the spectrum. This led us to suspect that they were due to ozone, and the suspicion was readily confirmed by experiment. Burning magnesium ribbon gives a convenient source of continuous spectrum in the ultra-violet region. Interposing a long tube containing ozone between the burning magnesium and the slit, a series of bands was photographed which exactly corresponded to those photographed in the solar spectrum with the same instrument, as you will see in the slide shown.

Absence of Ozone near the Ground.

We are then driven to the conclusion that the absence of short waves from the spectra of the sun and stars is due to absorption by terrestrial ozone. But it was not thought desirable to let the matter rest there. It is true that many attempts had been made to determine the (no doubt very small) quantity of ozone in air by chemical means, but with very conflicting results, because other constituents of air, such as oxides of nitrogen, are liable to produce reactions not unlike those of ozone. It seemed more satisfactory to test the absorbing power of air near the ground for ultra-violet rays, to which ozone is so opaque. I used for this purpose a mercury vapour lamp in a quartz vessel, which is a powerful source of ultra-violet rays, and observed its spectrum four miles away, so that the mass of air intervening was as great as that between the midday summer sun and the top of the Peak of Teneriffe, from which observations of the extent of the solar spectrum have been made. The result was to show that the mercury lamp spectrum was by no means stopped when the solar spectrum stops, but that it extended to the region where ozone is most opaque. There is a strong mercury line (wave-length 2536) at about this point which was distinctly photographed. Its intensity was of course a good deal reduced relative to the visible spectrum by atmospheric scattering. But there was no evidence whatever of ozone absorption.

What conclusion can we draw? Evidently that the absorbent layer of ozone in the air is high up, and that there is little or none near the ground. It may seem at first sight that this thin and inaccessible layer of ozone, which we have learned of by a chain of reasoning not less conclusive than direct observation, is a matter of little importance to man and his welfare. There could be no greater mistake. It acts as a screen to protect us from the ultra-violet rays of the sun, which without such a protection would probably be fatal to our eyesight: at least if one may judge from the painful results of even a short exposure to such rays, which those who have experienced it are not likely to forget.

The Future of the Iron and Steel Industry in Lorraine.

By PROF. H. C. H. CARPENTER, F.R.S.

DURING the spring of last year two Commissions were appointed by the Minister of Munitions to visit and report upon certain steel-producing areas in Western Europe. One of them visited the steel works in Lorraine and certain parts of the Saar Valley, the other journeying to the occupied areas of Germany, Luxemburg, and certain parts of France and Belgium. The former was under the charge of Sir William Jones, and included Messrs. Percy Cooper, Rowland Harding, and Cosmo Johns, while the latter was entrusted to Dr. F. H. Hatch, who had with him Messrs. L. Ennis, James Henderson, and Richard Mather. The Commissions were absent about three weeks. The terms of reference to them were the same and were to ascertain:—

(*a*) The character and extent of the technical and other developments which had taken place during the war, with special reference to the steps taken for the development of munitions output.

(*b*) The present condition of plant and machinery.

(*c*) The prospects of these areas either as competitors with or markets for British industries.

(*d*) The developments in fuel economy in the steel trades of these areas.

The reports furnished by the Commissions were printed in the first instance as confidential documents by the Ministry of Munitions, but have now been made public. That of the Commission which visited Lorraine and the Saar Valley is the more complete and interesting in that it throws light on the possibilities of development of the iron- and steel-producing area, which, as a result of the war and the Peace Treaty, has passed from German to French ownership.

The view of the Commission is that the acquisition by the French of these areas should be of advantage to British industries on the whole, and that while France may become a competitor with Britain in so far as her surplus steel production is concerned, taking the place of Germany to some extent, it will not be until the destroyed works have been reconstructed and full production has been reached in a period which it estimates at from three to five years. As a result of the war, France has replaced Germany as the possessor of the largest iron-ore supplies in Europe, her reserves having been increased by more than 2,000,000,000 tons, making them now about four times those of Germany. Before the war they were approximately the same.

Whereas France's production of pig iron in 1913 was about 5,000,000 tons, with her new possessions in Lorraine and the Saar Valley she is in a position to produce 11,000,000 tons annually. Prior to the war German steel makers frequently complained of the difficulty of obtaining adequate supplies of foreign ores, and this is regarded by many as one of the chief causes of the war, since they hoped thereby to obtain possession of France's ore reserves. The Commission states that whereas in 1913 Germany produced 27,000,000, and France 21,000,000, tons of iron ore, it estimates future production to be in the ratio of Germany 7,000,000 to France 42,000,000 tons. It would appear that outside France Germany can expect to obtain ore only from Sweden or Spain, but as both these countries are actively developing their steel industries they will probably not have very much to spare.

With regard to coal, however, France's position is by no means so satisfactory. Her pre-war production was about 40,000,000 tons, and her consumption 60,000,000 tons, the balance being obtained from Great Britain, Belgium, and Germany.

The control by France of the coal of the Saar Valley area is estimated to enable her to produce twice the tonnage obtained from the Valenciennes district. This would mean an addition of 17,000,000 tons to the annual output, which nearly meets the deficit. The Commission states, however, that the ideal of the French iron and steel makers in the Lorraine area at the present time is that means should be devised whereby a reciprocal business may be done with Great Britain by their supplying basic pig iron in exchange for furnace coke or coking coal. If the anticipated output of oven coke in this country is realised there should be some to spare, but the difficulties of transport, transhipment, etc., and the resultant breakage are serious factors to be considered. Possibly the solution of the present problem may be found in the erection of coke ovens in Lorraine close to the furnaces, and in the production of coke on the spot from a mixture of Saar coal and Durham coking coal. The supply of the latter cannot take place until better and cheaper means of transport are available.

The Commission states that France dreads the present position of dependence upon Germany for coke supplies, since, although the Peace Treaty gives her control of the Saar Valley coalfield for, at any rate, fifteen years, the fact remains that under existing conditions the works must have coal or coke from Westphalia for their blast furnaces. The coke obtained from Saar coal is apparently unsatisfactory, so that so long as this position continues French industry will remain to a great extent at the mercy of the Germans, a position the French are, naturally, most anxious to avoid. It is true that Germany will want iron ore from Lorraine, but she will not be so entirely dependent upon this one source of supply as the Lorraine works will be upon Germany for coke, unless some means are provided to enable them to obtain coke from elsewhere or to produce what they need from Saar coal and imported coking coal.

Various schemes for improved transport are under contemplation by France. The construction of a canal to Dunkirk from the Briey district known as the "Canal du Nord et de l'Est" has been under consideration for a long time. This would take at least five years to complete, and is not generally favoured by the French steel makers in Lorraine owing to the enormous cost of construction and the great difficulties to be overcome in cutting it through the densely populated industrial areas of Northern France. The scheme most favoured is that known as the canalisation of the Moselle from Coblenz to Thionville and thence to Metz, coupled with free navigation of the Rhine to Rotterdam or by canal from the Rhine to Antwerp *via* Maastricht. Either of these schemes, it is considered, would be much cheaper and more quickly operative than the canal to Dunkirk. The estimate of the cost of the Moselle Canal scheme would be between 15,000,000*l.* and 20,000,000*l.*, and it is calculated that the construction could be completed in three years. Plans for this scheme are in the hands of the French authorities. The strong feeling in favour of this scheme to enable reciprocal business to be done with Great Britain is accentuated by the treatment

accorded to the Lorraine steel works by Germany in the matter of coke supplies, since the Germans have failed to carry out their obligations under the terms of the Peace Treaty, and have delivered only about one-third of the tonnage promised, notwithstanding the fact that there are large stores of furnace coke in Westphalia. Since Great Britain has been short of basic pig iron for a long time, and there is every prospect of the shortage continuing, some such reciprocal arrangement as that put forward might be of advantage to both countries.

The Commission states that there is no doubt that economy in fuel consumption is very fully effected, owing to the absence of cheap and suitable fuel and the dependence of the works upon Westphalian coke. All the waste heat is utilised at every works. The blast-furnace gas is suitably cleaned and fully absorbed. The works at Homécourt may be cited as an instance. Before the war they were producing 9000 tons of pig iron and 7000 tons of steel weekly, and they used only 280 tons of coal, all the remaining power being produced from blast-furnace gas. This is quite typical. The molten metal is taken from the blast furnaces to the mixers in the adjacent steel works and the sensible heat thus utilised.

A study of the report leaves the impression that the development of the iron- and steel-producing areas in Lorraine which have passed from German to French management presents problems which will call for patient consideration, dispassionate counsel, and scientific treatment, if they are to be surmounted successfully. The formidable position which Germany had built up between 1871 and 1914 has been lost to her by the war. It remains to be seen what France will make of the heritage which has passed into her hands.

Obituary.

WE regret to note that the death of MR. JOHN W. W. DRYSDALE is recorded in the *Engineer* for June 25 as having occurred on June 21. Mr. Drysdale was in his seventy-second year, and was one of the founders of the well-known Glasgow firm of Drysdale and Co., Ltd. He finished his education at Glasgow University under Prof. Macquorn Rankine, and thereafter started a small works in conjunction with a fellow-student, Mr. Lewis J. Pirrie, son of Principal Pirrie of Aberdeen. Centrifugal pumps formed their outstanding speciality from the first, and the firm has acquired a wide reputation for its products. Mr. Drysdale was a member of the Institution of Engineers and Shipbuilders in Scotland.

WE announce with great regret the death, at the Queen Alexandra Military Hospital, Millbank, of SURGEON-GENERAL W. C. GORGAS, of the U.S. Army, so well known for his work in combating yellow fever and malaria.

Notes.

THE Lord President of the Council, as president of the Committee of Council for Scientific and Industrial Research, has appointed Dr. J. S. Flett, at present Assistant to the Director in Scotland, to be Director of the Geological Survey and Museum. Dr. Flett succeeds Sir Aubrey Strahan, who retires this month. Mr. G. W. Lamplugh, Assistant to the Director in England, also retires.

SIR JOHN CADMAN, Mr. W. B. Hardy, and Prof. S. Young have been appointed by an Order in Council members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

IT is announced that Sir T. Clifford Allbutt is to be sworn a member of the Privy Council.

THE secretaryship of the Royal Irish Academy, vacant through the death of Prof J. A. McClelland, has been filled by the election of Prof. G. H. Carpenter.

THE Barnard medal of Columbia University has been awarded to Prof. Einstein "in recognition of his highly original and fruitful development of the fundamental concepts of physics through the application of mathematics."

DR. E. SOLVAY has been elected an honorary member of the American Chemical Society.

THE Medical Research Council has recently established at the Lister Institute of Preventive Medicine a national collection of type cultures from which biologists in general, and bacteriologists in particular, may obtain authentic strains of recognised bacteria and protozoa for use in scientific work. The scheme is under the general direction of Dr. J. C. G. Ledingham, while Dr. R. St. John Brooks has been appointed to the post of curator of the collection and Miss Mabel Rhodes to that of assistant curator. It is proposed to collect and maintain bacterial strains from all departments of bacteriology, human, veterinary, and economic, and already considerable work has been done towards the formation of a representative collection on these lines. The efforts of the staff are, however, at present particularly directed towards the securing of fully authenticated strains responsible for or associated with disease in man and animals. The bureau proposes to supply cultures on demand to all workers at home and abroad, and, as a rule, a nominal charge per culture will be made to defray postage and media. Strains sent for identification and maintenance should be accompanied by particulars as to source, date of isolation, etc. In due course a catalogue will be prepared for publication.

IN NATURE of January 1 last an account was given of the Cawthron Institute of New Zealand, founded for the furtherance of scientific research in relation to agriculture and other industries. The scope of the institute has since been extended by the establishment of a biological department, of which Dr. R. J. Tillyard, the eminent Australian entomologist, hitherto

research fellow of Sydney University, has been appointed chief. He will be assisted by Miss K. M. Curtis as mycologist and Mr. A. Philpott as assistant entomologist. We understand that members of the scientific staff of the institute will have full freedom as to research and publication.

A COMMITTEE, composed of the following members, has been appointed by the Ministry of Health to consider and report on the legislative and administrative measures necessary to secure adequate protection for the health of the people in connection with the slaughter of animals and the distribution of meat for human consumption in England and Wales:—Sir H. C. Monro (chairman), Mr. W. G. R. Boys, Mr. R. B. Cross, Mr. J. Edwards, Dr. W. J. Howarth, Dr. A. W. J. MacFadden, Mr. T. Masheter, Mr. A. W. Monro, Mr. T. Parker, Mr. R. J. Robinson, and Mr. P. Taylor. Mr. H. F. O. Jerram is the secretary of the Committee, and communications should be addressed to him at the Ministry of Health, Whitehall, S.W.1.

IT was stated by Mr. Bonar Law in the House of Commons on Monday last, with reference to the question of scientific war inventions, that the Lord President of the Council is about to appoint an inter-Departmental Committee with the following terms of reference:—(1) To consider the methods of dealing with inventions made by workers aided or maintained from public funds, whether such workers be engaged (*a*) as research workers or (*b*) in some other technical capacity, so as to give a fair reward to the inventor and thus encourage further effort, to secure the utilisation in industry of suitable inventions, and to protect the national interest; and (2) to outline a course of procedure in respect of inventions arising out of State-aided or supported work, which shall further these aims and be suitable for adoption by all Government Departments concerned.

A SPECIAL meeting of the Röntgen Society is to be held at University College, Gower Street, at 9 o'clock on Thursday evening, July 15, when an address will be delivered by Dr. W. D. Coolidge, of the Research Laboratories of the General Electric Co., Schenectady, New York. An invitation to the meeting is given to the members of other scientific and medical societies.

A FREE public lecture on "Oil Storage, Transport, and Distribution" is to be delivered by Mr. H. Barringer at 6 o'clock on July 14 in the Canada Building, Crystal Palace, under the auspices of the Institution of Petroleum Technologists. The institution has also arranged for the delivery of four lectures, as follow, in September, the actual dates for which will be announced later: "Oil Prospecting," Mr. G. Howell; "Petroleum Refining," Dr. A. E. Dunstan; "Utilisation of Volatile Oils," Dr. W. R. Ormanby, and "Utilisation of Heavy Oils," Prof. J. S. S. Brame.

THE annual Oxford Ophthalmological Congress will take place in the Department of Human Anatomy in the University Museum, Oxford, on July 15 and 16. Among the promised communications are the following: The Doyne memorial lecture, by F. R. Cross, on "The Nerve Paths and Centres concerned with Sight": A. S. Percival, "Light Sense"; Dr. Van der Hœve, "Eye Symptoms in Tuberose Sclerosis of the Brain"; Dr. L. C. Peter and others, "Perimetric Methods"; M. Barton, "Examination of the Eyes of Pit Ponies, particularly with reference to Miners' Nystagmus"; A. H. Thompson, "Physiological and Glaucoma Cups"; R. D. Batten, "Premonitory Symptoms of Glaucoma"; and Dr. L. Sambon, "Ancient Eye Instruments."

THE Research Association for the Silk Industry has been approved by the Department of Scientific and Industrial Research as complying with the conditions laid down in the Government scheme for the encouragement of industrial research. The secretary of the committee engaged in the establishment of this association is Mr. A. B. Ball, the Silk Association of Great Britain and Ireland, Kingsway House, Kingsway, W.C.2.

THE jubilee of the American Fisheries Society will be celebrated at Ottawa on September 20–22 next. In connection with the meeting prizes will be offered for papers on the following subjects: Advance in practical fish cultural work; biological work connected with fish problems in general; and the solution of problems affecting commercial fisheries work. The competitive essays should be received by, at latest, August 20. Further information can be obtained from the executive secretary, Prof. R. C. Osburn, Ohio State University, Columbus, Ohio.

A PROPOSAL is on foot by the Swedish Linnean Society to restore the old botanic garden at Upsala, together with the house in it, the former residence of Carl von Linné, and subscriptions towards this object are solicited. Particulars of the suggested memorial can be obtained from the General Secretary of the Linnean Society of London, Burlington House, W.1, and donations sent to him or direct to the Swedish Linnean Society at Upsala.

ARCHITECTS, timber merchants, firms engaged in the building and furniture trades, railway companies, and, in fact, all users and consumers of wood, paper, and other forest products, should visit the British Empire Timber Exhibition, which is open to the public at the Holland Park Skating Rink, London, until July 17. The exhibition has been organised to display the forest wealth of the British Empire. Before the war the greater part of the immense importations of timber into the United Kingdom, some 10,000,000 tons annually, came from foreign countries, and many of these were closed during the war. This necessitated a considerable development of the sources of supply within the Empire and a greater demand on our home forests. The main object of the exhibition is a patriotic one, namely, to show that our timber requirements can be met in great measure from our Dominions and Colonies, thus extending Imperial trade. The specimens of timber include very many beautiful, valuable, and useful woods, of which only a few may be mentioned as examples, such as rosewood, satinwood, mahogany and its various substitutes, teak, greenheart, jarrah, ironwood, and the

numerous cedar woods. There is also a complete set of exhibits demonstrating the various uses to which timbers are put, as floors, panelling, veneers, plywood, furniture, and articles of everyday use. Many decorative exhibits are of great interest. The preparation of paper-pulp from bamboos is also shown. An exhaustive catalogue of the exhibits has been prepared. This gives both the botanical and trade names, the countries of origin, and names of shippers and importers. Each wood is fully described as regards its general characteristics, tension strength, and other useful data. The information in the catalogue has been compiled by the various Forest Departments of the Empire, and has a scientific as well as a commercial value.

THE half-yearly report of the Department of Civil Aviation on the progress of civil aviation from October, 1919, to March, 1920, contains many features of general interest. A very detailed survey of the results which have been achieved is given with regard to activities both in the British Empire and in foreign countries. Tabulated figures concerning the operation of air services between England and the Continent show that a slow but definite progress has been made. The importance of the International Air Convention is emphasised, and it is satisfactory to note that this Convention has now been signed by all the Allied Powers. The record of activities in foreign countries shows that many attempts are being made to develop commercial flying for both inland and international trade. France and Italy show the most promising results, and both are making efforts to exploit the possibilities of commercial aviation in Asia and South America. In late enemy countries many aviation companies have been formed to develop commercial flying, but no actual results have yet been achieved owing to the economic conditions prevailing. The first paragraph of the conclusion of the report is worthy of quotation as an apt summary of the present position. The Controller-General says:—"The discovery of a new method of increasing the speed of inter-communication has in the past generally indicated a fresh step in the march of civilisation. In aviation a means of transport has been obtained twice as fast as any other previously existing. The majority of countries which are imbued with the spirit of progress appear to realise that the future of aviation cannot be neglected, and by various methods, such as the creation of aviation departments, research, subsidies, and the conduct of experimental services, are striving to adapt aviation to commerce." Progress may be somewhat slow under the unsettled conditions which now prevail throughout the world, but there is little doubt that as the general economic situation improves, so will the advance of civil aviation become more rapid.

IN 1910 Dr. W. Max Müller was enabled, through the liberality of the Carnegie Institution of Washington, to visit the doomed island of Philæ, and to glean the epigraphic material left by the Berlin expedition. His immediate purpose was the decipherment of the famous bilingual inscriptions engraved on the walls of the large court between the first and the second pylons. This was exceedingly difficult, as the small, shallow-engraved signs become distinctly visible only during the short time of the day when they receive strong light. The Carnegie Institution has now published in a suitable style the result of Dr. Max Müller's labours. He gives complete facsimiles, transliterations, and translations of the inscriptions, and a learned introduction adequately reviews the historical information thus collected. The work is in every way creditable to the learned explorer and the Carnegie Institution.

IN the University of California Publications in American Archæology and Ethnology (vol. xvi., No. 6) Miss Lucile Hooper gives a valuable account of Shamanism among the Cahuilla Indians, one of the largest surviving tribes in Southern California. At one of their *fiestas* or annual rites the Shaman first took a dark substance from his breast; then "he reached into the fire with his foot and kicked out a few coals. One of these he picked up; it was about the size of a dollar. He immediately put it into his mouth. I was only a few feet away, and one of the sparks from his mouth, as he blew, fell on my hand, so I can testify that they were hot. The glow from the coal could be seen on the roof of his mouth. He swallowed it in about a minute. He swallowed three coals in this way." The dancing and singing are part of the rite. One man intended to eat the coals, "but his song had not gone right; he had forgotten part of it, no doubt due to some disturbing influence among those watching, or perhaps because of some spirit preventing his success. Since his song did not go right, he could do nothing." Other marvels of a similar kind are reported. "Another man saw a dove walking around; he raised his hands and clapped them together. The dove dropped as though dead, and blood flowed from its mouth. He then picked it up, threw it into the air, and it flew off as though nothing had happened." The report includes a full account of the religious and domestic rites practised by the tribe. Their pottery, which was of an interesting type, has now disappeared with the use of manufactured articles.

AN interesting report, by Mr. R. S. White, on an outbreak of pellagra amongst Armenian refugees at Port Said during 1916–17 has been published (Reports and Notes of the Public Health Laboratories, Cairo, No. 2, 1919). Much controversy has occurred with regard to the nature of this disease. In the outbreak in question the weight of evidence points entirely to a faulty diet as the causal factor, and the disease was eradicated from the camp by correcting this, all other conditions remaining the same. The diet at the time had an energy-value of about 2000 Calories only, which is very low, the protein amounting to but 46–48 grams, of which some 90 per cent. was derived from vegetable sources and was of low biological value. Maize had no direct causal relation to the disease. No protozoan or bacterial cause was discovered, nor could any connection with biting insects be found. The results of the inquiry are in accordance with the findings of Goldberger in the United States.

MR. FRANCIS HARPER, the assistant biologist of the United States Biological Survey, contributes to *Natural History*, the journal of the American Museum of Natural History, vol. xx., No. 1, an article of remarkable interest on the Okefinokee Swamp, which covers nearly seven hundred square miles of the south-eastern part of the State of Georgia. "It has no counterpart anywhere in the world." Drainage and the "lumber-man" threaten its existence, and unless the hand of the destroyer can be stayed it is certain that a considerable number of vanishing birds and beasts will be swept out of existence, this swamp being their last stronghold. In 1918 a society was formed for the purpose of securing the swamp as an educational and scientific reservation, and it is devoutly to be hoped that this aim will be secured; for such areas are of immense value, not only to the people of America, but also to the world of science at large.

WE have received from the American Museum of Natural History a brief preliminary report on the zoological collections made under its direction in the Belgian Congo territory during the years 1909–15. Of mammals, birds, and fishes respectively there are about 6000 specimens, of reptiles and batrachians nearly 5000, and of invertebrates more than 100,000. Material has been obtained for mounted groups of the okapi and square-lipped rhinoceros in their natural surroundings. There are also 3800 specimens illustrating anthropology. It is anticipated that the scientific papers on the collection will occupy twelve volumes of the Museum Bulletin, and a monograph of the okapi is being prepared for the Memoirs. There will also be a Narrative in two volumes and an Ethnological Album in three volumes. In consideration of the generous co-operation of the Belgian Government, a selection of duplicate specimens will be sent to the Congo Museum at Tervueren.

THE Crocker Land Expedition to North-West Greenland and Grinnell Land covered a district but little visited previously by naturalists. The mollusca obtained on the expedition by Dr. M. C. Tanquary and Mr. W. E. Ekblaw have now been described by Mr. F. C. Baker (Bull. Amer. Mus. Nat. Hist., vol. xli., 1919, pp. 479–517, pls. 25–27). No new species are claimed, but the number determined exceeds by four those obtained on the Nares Expedition of 1875–76, when thirty-four were enumerated by the late Mr. E. A. Smith. The more important species of Astarte and Buccinum have been figured, with the detailed sculpturing of the shells of the latter, but the chief interest in the collection is the number of species found in high latitudes and the extension of the northward range of several of the species. The same author (*tom. cit.*, pp. 527–39, figs.) also describes a number of fresh-water mollusca obtained by Prof. Frank Smith from various lakes in Colorado and Alberta. Fifteen species in all are dealt with, of which three are believed to be new.

A PRELIMINARY account of the Tasmanian skeleton of Nototherium, to which we referred in last week's issue (p. 559), was read before the Royal Society of Tasmania on May 10 by Messrs. H. H. Scott and C. Lord. The authors assign the specimen to *N. Mitchelli*, and consider that it was originally provided with a horn on the nose. They regard the Nototheria as the marsupial analogues of the rhinoceroses, some of them horned, others hornless.

THE atmosphere that surrounds the *Revue des questions scientifiques*, which is published at Louvain for the Société scientifique de Bruxelles, permits of the most liberal agnosticism in regard to scientific dogmas. Prof. Pierre Termier, in his address on "Les grands énigmes de la Géologie," delivered in the welcome epoch of recovery at Louvain in 1919 (*Revue*, vol. xxvii., p. 53, 1920), responds with his accustomed vigour to the invitation of his northern colleagues. His splendid oratory rings through these pages, in which he brings us face to face with the sphinxes that rise in the domain of geological inquiry and raise in the soul of the traveller "des pensées vertigineuses et des rêves sans fin." In his desire to show how much remains truly enigmatic, he makes no mention of tentative or even probable explanations, and his hesitating spirit before the evidences of organic evolution seems the pose of the courteous guest rather than the free expression of the prophet. For Prof. Termier, in his mere use of language, is a prophet and a power, and he hopes yet to see some secrets wrested from the earth as part of the general movement of humanity towards light and truth. On p. 149 of the same number of the *Revue* M. P. Teilhard de Chardin, who was present with the late Mr. Dawson at Piltdown, gives an excellent account of the human remains that have excited so much controversy, and he assures his readers that when palæontologists come to an agreement it is because they believe loyally and invincibly that their judgment has been based on truth. It is evident that these things still need saying, even in *sociétés scientifiques*, though we may have advanced some way from the scene so bitterly depicted by Barabino in his "Colombo deriso" at the Council of Salamanca.

THE New York Academy of Sciences has published two more parts of the results of its scientific survey of Porto Rico and the Virgin Islands (vol. i., part 2, and vol. iii., part 1). Porto Rico is largely and essentially a heap of volcanic *débris*, and Mr. Edwin T. Hodge attempts to unravel its geological history after making a detailed study and map of the Coamo-Guayama district. He also adds some useful notes on its mineral resources and hot springs. The limestones inter-stratified with the volcanic tuffs contain numerous fossil shells, which are, unfortunately, preserved only as impressions, but clearly represent several horizons between the Eocene and Miocene Tertiary. The shells are described in detail, with beautiful illustrations, by Miss Carlotta J. Maury, who makes some interesting remarks on their relation to the molluscs of existing seas. She points out that most of them are represented by living species which are evidently their descendants in the Antillean seas, but that several of the Tertiary genera have now completely disappeared from the Caribbean region, and exist only in the Pacific Ocean. The latter must have spread before the Isthmus of Panama arose, and it is

difficult to understand why they survived only on the western side of this barrier of land.

THE *Meteorological Magazine* for June deals with the recent disastrous flood at Louth as completely as possible at the time of going to press, and adds somewhat to the account in NATURE of June 10 (p. 468). The characteristic features are given of the hot weather experienced over England during the last week of May, which occasioned the development of numerous thunderstorms. A disturbance, centred over the Bristol Channel on the morning of May 29, traversed the Midlands during the day. Little or no rain fell on May 29 south of a line passing through Plymouth, Reading, and Lowestoft, and none was observed over the centre and west of Scotland. There was more than an inch of rain over the greater part of Lancashire, the West Riding of Yorkshire, Lincolnshire, and the east of Nottinghamshire. In Lincolnshire the rainfall was very severe. At Louth the fall was only 1·42 in., but at Elkington Hall, three miles to the west, the fall was 4·69 in., and of this 4·59 in. fell in three hours. At Hallington, about two miles south, 4·10 in. fell in two hours, when the gauge overflowed and the exact total fall was lost. Ten miles further south, at Horncastle, 3·95 in. fell in three hours. The magazine states that, according to the Borough Surveyor, the Lud stream, normally 3 ft. wide and 1 ft. deep, was swollen to a width of 52 yards and a depth of 50 ft. It appears that the stream was temporarily blocked with *débris*, and the flood was the result of the sudden breaking down of this obstacle. The periodical has a very suggestive and useful article on the ventilation of instrument shelters by the Director of Armagh Observatory. The general rainfall for May in England and Wales was 117 per cent. of the average, in Scotland 164 per cent., and in Ireland 145 per cent.

THE report of the Imperial Wireless Telegraph Committee (Cmd. 777, price 6*d*. net) contains an interesting review of the capabilities of different systems of wireless transmission for long-distance working, and forms a striking vindication of the powers of the thermionic valve, which it is proposed to employ as the sole means of generating the waves required for the chain of stations 2000 miles apart which are recommended. We admire the courage of the Committee in putting forward a system which, in its own words, "departs widely from the general direction of contemporary practice." It admits that "the objects desired might perhaps be secured by other and more conventional methods, but by none, in our opinion, not involving an immediate capital expenditure and a heavy annual loss which the scientific progress of a few years might well prove to have been unnecessary." Discussing the alternative systems, the Committee dismisses even the latest developments of the spark system as obsolete. The high-frequency alternator system it characterises as "costly, difficult to repair, and as yet insufficiently tested in prolonged operation." The arc system is described as "pre-eminent at the present moment among methods of long-range wireless transmission." Arcs of greater power than 250 kw., however, present elements of uncertainty, and apparently do not deliver to the aerial a greater effective current than those rated at lower powers. Although the valve system cannot show the same degree of accomplished results as any of the preceding, the Committee has evidence of such rapid advances now being made that it recommends its adoption without hesitation. It has already been found that a group of three glass valves delivering 2½ kw. into the aerial can effect communication over two thousand miles. Silica valves are now designed by means of which, with suitable grouping, 120 kw. will, it is hoped, be delivered into the aerial. Owing to the greater purity of wave-form of valve-generated over arc-generated waves, this arrangement should be considerably more effective than a 250-kw. arc, which does not really deliver more than 120 kw. into the aerial. There are several other advantages for valve working claimed in the report which we have not the space to mention here.

THE deposition of iron by electrolysis is a method which has lately been employed to a considerable extent for the purpose of "building up" worn and under-gauge parts of both aeroplanes and guns. The work, however, has not been done under proper scientific control, and not infrequently defects have manifested themselves in use in the iron thus deposited. A paper dealing with some of these was presented by Mr. W. E. Hughes at the recent meeting of the Iron and Steel Institute. In his capacity as chief research chemist to the Electrometallurgical Committee of the Ministry of Munitions, Mr. Hughes had opportunities of making extended observations upon the structure of the electro-deposited metal. He found that it was liable to contain pinholes, lumps, inclusions of foreign matter, cracks, and "quasi-cracks," and that a given specimen might present very marked differences of structure. He concludes that these defects may render the iron dangerous and unsuitable for engineering purposes, but that they arise from causes which can be largely eliminated by efficient control of the deposition process. It is generally assumed that electrolytic iron is a very pure product, but, as he shows, this is by no means necessarily the case. Further, it is usually assumed to be hard, and may indeed be so, though not always. Whether the hardness, when it occurs, is due to included hydrogen is a question which has not yet been settled. Mr. Hughes's investigation has proceeded sufficiently far for him to entertain decided doubts about this explanation.

MESSRS. DULAU AND CO., LTD., 34 Margaret Street, W.1, have just issued an important catalogue (No. 83) of secondhand books of science in the departments of ornithology, entomology, general zoology, geology and palæontology, geography, travel, and topography, botany and horticulture. Of the 1256 works listed many are out of print and not easily obtainable. The catalogue can be had free upon request.

ANOTHER of the useful catalogues (No. 403) of Mr. F. Edwards, 83 High Street, Marylebone, W.1, has reached us. It consists of descriptions of some seven hundred works relating to Central and South America, and should be of interest to many readers of NATURE.

Our Astronomical Column.

COMMENCEMENT OF THE GREAT PERSEID SHOWER OF METEORS.—The first Perseids probably appear at the end of June. They have certainly been observed in the first week of July. The earliest meteor of this shower, which has been doubly observed and the real path of which has been computed, was seen on July 8, 1918, by Mrs. Fiammetta Wilson and Miss A. Grace Cook. This year the moon left the evening sky about July 6, and the sky should be watched for traces of oncoming Perseids. At this time of the year meteors generally increase in numbers, and especially after the middle of July. The Perseids gradually become more abundant, and among the minor displays the chief ones are:

δ Aquarids	...	338−11	ο Draconids	...	291+60
α Capricornids	.	303−11	λ Andromedids	.	350+51
θ Cygnids	...	292+52	ζ Pegasids	...	332+10
α Perseids	...	48+44	β Cepheids	...	333+71
α Cygnids	...	315+48	Lacertids	...	334+51

The radiant point of the Perseids moves N.N.E. as follows:—

July 8	...	9+46	Aug. 1	...	33+55
16	...	16+49	9	...	43+57½
24	...	24+52	17	...	54+59

THE EXPANDING DISC OF NOVA AQUILÆ.—Dr. Lunt contributed a paper on this nova to the June meeting of the Royal Astronomical Society which contains some interesting calculations on the rate of expansion. It was written before the recent Lick measures, which indicate a mean annual rate of increase of diameter of 1·9″, but he notes that Barnard's measures gave an increase of 2″ in the first six months, so that the rate may be diminishing.

Assuming the displacements of the edges of the bands in the spectrum to be a measure of the rate of expansion of the nova into a planetary nebula, Dr. Lunt found a radial velocity of 1500 km./sec., which would give a diameter of 1/100 light-year in a year, and would imply a distance of the nova of 1000 light-years.

According to Van Maanen's parallax of the ring nebula in Lyra (the largest nebula on his list), its diameter is 0·16 light-year. The expanding nova would attain this size in sixteen years if the rate were maintained.

Dr. Lunt notes that in the nova spectrum there are fine dark lines close to the normal positions of the H and K lines of calcium, which indicate a motion of approach to the sun of 17 km./sec., exactly the amount due to the sun's own motion. A similar feature has been noted in several other stars, and the suggestion made that these lines arise from clouds of very tenuous calcium vapour at rest in space. On this view these lines exist in the spectra of most stars, but are hidden by the star's own lines unless the latter are shifted by a large radial motion.

THE NEW MINOR PLANET GM.—It will be remembered that last January Señor Comas Sola, of Barcelona, discovered a new minor planet which was much brighter than most of those discovered in recent years, and was taken for a comet by some observers. The object was very well observed for several months, so that an accurate determination of the orbit is possible, and there is not much fear of its being lost again, as has happened to many of these little planets. The discoverer has now given it the name "Alphonsina," in double homage, as he says, to Alphonso X. of Spain, who was known as "the Savant," and to the present king, Alphonso XIII.

Annual Visitation of the National Physical Laboratory.

ON the occasion of the visitation of the National Physical Laboratory by the General Board on June 22, a large number of distinguished visitors availed themselves of the opportunity of inspecting the laboratory. The visitors were received by the chairman of the board (Sir Joseph J. Thomson) in the 7-ft. wind channel of the new aeronautics building, and afterwards visited the various departments of the laboratory, where exhibits illustrative of recent work were on view.

The exhibit in the engineering department was noticeable for the large number of machines for testing resistance to shock and to fatigue. The day is past when a simple test in tension is considered to yield sufficient data for structural material, and many other forms of test are now in use. One machine, designed by Dr. B. Haigh, subjects the specimen, by means of an alternating magnetic flux, to a maximum load of ±0·75 ton reversed two thousand times every minute. Another instrument, designed and constructed in the department, tests the endurance of stranded cables passing over pulleys. Among the impact testing machines, many of which were designed and made in the department, mention may be made of one in which both hammer and anvil are swung; by this means it is possible to obtain a striking velocity as high as 43 ft. per second. Machines for measuring the elastic limits of materials at high temperatures and for determining the efficiency of chains, gears, etc., were also among the exhibits.

In the aeronautics department various wind channels were operating, measurements of the performance of air-screws, the effects of aeroplane bodies on screws, and stability tests on bodies being carried out. Apparatus for measuring the skin-friction of air passing over thin plates was also exhibited.

Amongst the exhibits in the metallurgy department were a number of examples of failures of steel and alloy articles which had been sent in for investigation. Photomicrographs illustrating sections from these, as well as various sections under the microscope, were shown.

The representation of the constitution of a series of ternary alloys has never been an easy matter. Three models were exhibited which are designed to overcome this difficulty. They represent parts of the "diagram" for copper-aluminium-zinc alloys and a part of the aluminium-magnesium-silicon "diagram."

Considerable improvement has recently been introduced into the manufacture of thin-walled refractory tubing for thermo-couple protection and insulation; the apparatus with which it is made was shown in operation.

Demonstrations of the rolling of manganin, cast at the laboratory, into rods prior to wire-drawing were given in the rolling mill. Much valuable work has been done, in conjunction with the electricity department, on this metal, and it is now possible to produce manganin wire equal to the best pre-war material which was imported from Germany.

A modified form of the Shakespeare katharometer, used for measuring the permeability of balloon fabric, was in operation in the aeronautical chemistry division.

The exhibits in the Froude national tank can be divided into three heads. The first dealt with tests on the trim, the longitudinal stability, and the resistance of hulls of flying-boats. The second was work which was being carried out for Lloyd's Register in

connection with the design of oil-tankers to determine the stresses in the bulkheads of the oil compartments when the ship is pitching. The effect of varying the frequency of the pitch was studied. Thirdly, an apparatus was shown for testing the effects of a screw propeller working behind a ship. If we know the thrust which the screw must develop, and the velocity of the water behind the ship where the screw is working, relative to the velocity of the ship, then the ordinary data can be used to find the dimensions of screw required for a particular service. The object of the experiments is to find out these two factors.

The heat division of the physics department exhibited, amongst other things, a method of measuring humidity based on the property, shown by dry cotton, of absorbing moisture at a very high rate. Two similar coils of cotton-covered wire, one of which is coated with cellulose, are wound on to a single bobbin and connected up to the two sides of a Wheatstone bridge. They are dried by being inserted into a tube containing P_2O_5, a current being passed through them at the same time to ensure complete drying. The coils are then drawn out of the drying tube into the atmosphere the humidity of which is to be measured; the cotton on the uncoated wire absorbs moisture with extreme rapidity, which causes a rise in temperature of the wire, thus upsetting the balance of the bridge and deflecting the galvanometer.

Another exhibit consisted of a pointolite lamp for calibrating optical pyrometers. The special feature of this instrument is that the tungsten disc had a tungsten-molybdenum couple fused into it, by means of which it was possible to measure the temperature of the disc.

In the optics division of the physics department an apparatus was shown for measuring the coefficient of expansion of short specimens. It has been used lately for determining the coefficient of expansion of various glasses, and has given very interesting results. Interferometer tests and methods of measuring refractive indices were also shown.

One of the most interesting exhibits in the metrology department was a machine which was constructed to measure accurately to one-millionth of an inch. Slip-gauges are now made accurate to 1/100,000 in., and to test them it is advisable to have a machine which can read to one-tenth of this. The machine is used as a comparator, *i.e.* it measures the difference between the standard gauge and the one under test. The chief feature of the instrument is the complete absence of a micrometer head. The magnification is obtained partly mechanically, but mainly by a tilting mirror, which moves the image of a cross wire over a paper scale, giving a magnification such that a movement of $\frac{1}{4}$ in. over the scale corresponds to a difference in length of 1/100,000 in.

Another machine, for comparing end standards with line standards, can be used for lengths up to a metre. An important point about this instrument is that the two standards under comparison are in the same straight line.

A new type of micrometer for measuring the diameter of small balls, rollers, etc., was also shown, in which the readings are made on two parallel circles, one of which drives the other through epicyclic gearing; tenths and hundredths of an inch are read on one circle, and thousandths, ten-thousandths, and, by estimation, hundred-thousandths on the other. Both sets of readings are in line with each other, making the instrument very rapid to read. The position of contact is found by means of a small mirror moved by the tail-stock of the instrument.

The list of exhibits in the electricity department was large and interesting, but there is only space for reference to a very few of them. A considerable number dealt with photometry. Others were concerned with the temperature coefficient of manganin, with the measurement of frequency, efficiency, amplifying power, and characteristics of electric valves, and with a selenium-cell current regulator.

The Carnegie Foundation and Teachers' Pensions.[1]

TEACHERS' pension controversies are not confined to England. All our recent discussions of this subject have their counterparts in the United States, but there they are immensely complicated by the lack of co-ordination between the different States of the Union. Great diversity exists between the school pension systems which have been adopted or are under consideration, and no attempt seems to be made to bring them into relation one with another.

The universities and colleges (or such of them as are admitted into association) are the special province of the Carnegie Foundation for the Advancement of Teaching, and the fourteenth report of this body contains evidence of work of great value. Beginning in 1905 with an initial benefaction of ten million dollars, the endowment administered by the trustees has been increased by later gifts and accumulated interest to more than twenty millions. The object of the founder was to provide retiring pensions for teachers in universities, colleges, and technical schools in the United States, Canada, and Newfoundland "without regard to race, sex, creed, or colour"; but the granting of pensions does not by any means represent the whole of the activities of the trustees. To enable them to discharge effectively the duty laid upon them, they have felt compelled to conduct many inquiries and, when necessary, to offer fearless criticisms, and by these means they have undoubtedly exercised a powerful influence on the quality of higher education in America.

During the year 1918–19 the trustees disbursed in retiring and widows' allowances a sum of more than eight hundred thousand dollars. But in that year the old plan of granting such allowances was definitely abandoned in favour of a scheme under which the teacher himself is called upon to contribute towards the provision for his own retirement. It is of special interest to observe that, at the time when we in this country were adopting for school-teachers a national pension system on a non-contributory basis, which many university teachers wish to be extended to themselves, the Carnegie Foundation had come to the conclusion, as a result of thirteen years experience, that a "free pension" could not be a solution of the problem in a democratic country, but that the system must be contractual and rest upon the co-operation of the teacher and his college. This method, in the opinion of the trustees, is the only one that is "just, feasible, and permanent." To this end they organised a Teachers' Insurance and Annuity Association, in the control of which the teachers themselves will have real representation, and invited the universities and colleges to adopt pension schemes based on joint contributions by the teacher and his institution and worked by means of policies issued by the new association. The trustees continue the system of free pensions for those who were in the service of associated institutions before a certain date, but for others will content themselves with the pro-

[1] Carnegie Foundation for the Advancement of Teaching. Fourteenth Annual Report of the Chairman and of the Treasurer. (New York, 1919.)

vision of disablement allowances and the guarantee of a certain rate of interest on policies issued by the association.

We see, therefore, that, through the administration of a great private benefaction, there has been evolved in America a pension system which in general form is not dissimilar from the Federated Superannuation System for Universities and University Colleges in this country. There are, however, important differences. Whereas our federated system is in all essentials applied uniformly throughout the institutions concerned, the new system in America is subject to a variety of conditions as to the rate of contribution, the grades of staff admitted, and other qualifications as to length of service and amount of salary. Also, while some institutions make entrance to the scheme compulsory on all members of certain grades of staff, others leave it entirely to the option of the individuals. So long as this lack of uniformity continues, the simplicity of transfer from one institution to another, so valuable a feature of the English system, can scarcely be secured. It is further to be observed that the rate of contribution of the American college is never more than 5 per cent., as compared with the 10 per cent. now generally given by the English university; but against this must be put the fact that the policies issued by the American Teachers' Association are a little more generous in their terms than those of the insurance companies in our federated system.

A particularly useful section of the fourteenth report of the Foundation is that which deals with current pension problems both in America and in this country. It is here that we are most impressed with the almost chaotic condition of the pension arrangements in America as a result of the diversity of the State systems; but we are bound, on the other hand, to confess that our own Fisher scheme, while admitted to be generous, comes in for severe criticism, especially on account of its non-contributory basis and of the alleged weakness of the arguments used to support the adoption of a scheme of that character. Indeed, throughout the report the virtues of the contributory plan are urged repeatedly and with great insistence, and we cannot dismiss lightly the opinions of an authority occupying the unique position of the Carnegie Foundation. Though perhaps not within the sphere of immediate practical politics, it is legitimate to conjecture whether greater advantage would not result from a contributory system of pensions applied to the whole of our teaching profession than from a non-contributory system granted to a part of it. By the former plan we should recognise the essential unity of a great profession; by the latter we tend to separate it into parts and hamper the free interchange of teachers between one institution and another.

Those who are concerned in unravelling the knots in our own pension systems will find much suggestive material in this and previous reports of the Carnegie Foundation. But it is gratifying to feel that without the colossal munificence of a Carnegie we have yet reached a position which, with all its weaknesses, is still in many ways far in advance of that occupied by our Transatlantic cousins. Though we may regret lost opportunities, we realise that in a comparative sense we are not so badly off as we thought, and we are led to ask ourselves whether, after all, the scheme inspired by Sir William M'Cormick's Committee and designed by our universities in co-operation does not represent the best thing so far done in the matter of teachers' pensions.

In addition to its achievements in the pensions field, a valuable series of educational reports stands to the credit of the Carnegie Foundation. Under this head the papers contained in the fourteenth report on current tendencies in education, on legal education, and on the training of teachers are worthy of notice, though perhaps not so much for their discovery of new ideas as for their clear exposition of accepted principles and their straightforward description of the good and the bad in existing practice.

National Food Consumption in the United States.

PROF. RAYMOND PEARL has contributed to the Proceedings of the American Philosophical Society (vol. lviii., 1919, p. 182) an instructive article upon the consumption of foodstuffs in America from 1911 to 1918. He distinguishes between (1) primary foods, such as plant materials directly consumable by man, or animals not nourished upon primary foodstuffs, and (2) secondary foods, which cover the edible products of animals nourished upon primary foodstuffs. The necessary deductions were made for loss in storage, transit, etc., and for inedible refuse. The statistics are expressed in terms of metric tons of proteins, carbohydrates, and fats, and also in terms of Calories.

Broadly speaking, the salient feature of the analysis is the uniformity of consumption from year to year. The greatest relative advance (relative, that is, to the increase of population) was in the consumption of fat, the least in the consumption of protein, but the deviations from the line of increasing population are small.

Turning to the sources, it appears that 47 per cent. of the protein is derived from primary, and 53 per cent. from secondary, foods. Of fats, 82 per cent. are derived from secondary sources, while 95 per cent. of the carbohydrates come from primary sources. In terms of Calories, 61 per cent. of the intake is from primary foodstuffs.

These figures are not greatly different from the British returns analysed by the Food (War) Committee of the Royal Society. We derived 42 per cent. of our protein, 92 per cent. of our fat, and 35 per cent. of our energy from secondary sources. Put otherwise, we get fewer Calories and less protein, but more fat, from animal sources (exclusive of fish, which comes under primary sources in Prof. Pearl's classification) than the Americans. We should, perhaps, use the past tense in this comparison, since the British data do not refer to existing conditions.

Thirty-six per cent. of the American intake of protein is in the form of grain, 26 per cent. in meats, and 20 per cent. in dairy products. Of fat, 51 per cent. is furnished by meats, 27 per cent. by dairy products, and 12 per cent. by vegetable oils and nuts. Of carbohydrates, 56 per cent. is furnished by grains and 26 per cent. by sugars. Of total energy, 35 per cent. comes from grains, 22 per cent. from meats, 15 per cent. from dairy products, and 13 per cent. from sugars. These four groups contribute 85 per cent. of the total energy value.

The effects of the food economy campaign and the food administration in 1917–18 are of interest. The total consumption of food increased, but not in proportion to the population; the consumption of meat practically did not increase at all, and the consumption of grain only 1 per cent. The great increases were in the consumption of vegetables, of oils and nuts, and of oleomargarine, amounting respectively to 30 per cent., 29 per cent., and 116 per cent over the averages of the preceding six years. The increase in the two former groups may have been due to the activity of

the Food Administration in urging the consumption of these commodities to relieve the pressure upon wheat and animal products. The increased consumption of oleomargarine was no doubt due to a favourable price in comparison with that of butter and lard.

Prof. Pearl provides a summary of daily consumption per "man," which again brings out the uniformity from year to year. The largest figure is 4361 Calories in 1913–14, and the smallest 4211 in 1916–17. The average figures are: 121 grams of protein, 169 grams of fat, and 542 grams of carbohydrate, yielding 4290 Calories. Assuming that 5 per cent. of protein, 20 per cent. of carbohydrate, and 25 per cent. of fat are lost in the wastage of edible substances, the *per capita* average of ingested food becomes:—Protein, 114 grams; fat, 127 grams; and carbohydrate, 433 grams, yielding 3424 Calories. These final figures are in good accord with the results of dietetic studies both in America and in England. Prof. Pearl justly remarks that "discussions of the minimum protein, fat, and carbohydrate requirements of a nation are in a considerable degree academic if they base themselves upon net consumption rather than gross consumption. A considerable excess over any agreed-upon minimum *physiological* requirements must always be allowed, because there will inevitably be, in fact, a margin between actual gross consumption and net physiological ingestion or utilisation."

The report is a useful contribution to knowledge. It is to be feared that since the armistice little attention has been devoted to the study of national dietetics in this country. During the war British physiologists made valuable experimental and statistical contributions to the subject; on the statistical side the work of the late Sir William Thompson, and on the experimental side that of Prof. Cathcart and his collaborators, deserve special mention. It is to be regretted that there is little prospect of the foundations then laid being built upon; it will be long indeed before the task of feeding the nation ceases to cause anxiety and to merit scientific elucidation.

M. G.

Engineering Research in the U.S.A.

THE problem of co-ordinating the interests and activities of the various engineering institutions and societies has been subject to much discussion in this country. In America this problem was largely solved by the establishment in 1904 of the United Engineering Society, which combined the interests of four founders' societies, namely, the American Society of Civil Engineers and the American Institutes of Mining and Metallurgical Engineers, Mechanical Engineers, and Electrical Engineers. The United Engineering Society now numbers some forty thousand members, and its administration comprises three principal departments, namely, the library board, the engineering council, and the engineering foundation. The last-named department is of particular interest, and is directed to the furtherance of research in science and engineering.

The engineering foundation was established as a result of a gift of 200,000 dollars by Mr. Ambrose Swasey, this sum being used as the nucleus of a fund the income of which was to be devoted to research or for the advancement in any other manner of the profession of engineering and the good of mankind. This first gift was made in 1914, and in September, 1918, Mr. Swasey added a further sum of 100,000 dollars to the endowment.

The donor is an engineer and manufacturer, and president of the Warner-Swasey Co., of Cleveland, Ohio, a firm manufacturing fine tools and astronomical and other instruments of precision. Mr. Swasey is a member of most of the American engineering societies, and of several English scientific societies, including the Royal Astronomical Society. He is the author of a number of papers read before American engineering societies.

For all practical purposes the engineering foundation is a professional trust organised along the lines of the Carnegie, Rockefeller, and Sage foundations. The facilities it provides have heretofore been devoted principally to engineering research, and its most notable work has been conducted through co-operation with the National Research Council, which is an organisation of men of science, engineers, and educators brought into being by the National Academy of Science at the request of President Wilson in 1916, and employed largely in the conduct of scientific investigations relating to anti-submarine and other war problems.

When the National Research Council was formed the administrators of the engineering foundation made themselves responsible for its financial support for a period of one year, and this brought into successful co-operation a body of engineering and scientific men in a comprehensive and practical manner.

Since July, 1919, the research work undertaken by the foundation has been of a very comprehensive nature. It has included, for example, preliminary researches on such subjects as a new hardness testing machine, the elimination of casting defects from steel, the uses of cadmium, the uses of alloy steels, Neumann bands in iron and steel, the heat treatment of carbon steel, electrical insulation, and substitute deoxidisers. A sum of 15,000 dollars a year for a period of two years has been voted for the conduct of research in the fatigue phenomena of metals in the laboratories of the engineering experiment station of the University of Illinois. From approximately fifty suggested subjects, the engineering foundation has also selected for investigation: (1) The wear of gears, (2) spray camouflage for ships, (3) the directive control of wireless communication, (4) weirs for the measurement of water, (5) the establishment of a testing station for large water-wheels and other large hydraulic equipment, and (6) the mental hygiene of industry.

These investigations are now all in progress or have been completed. Particular attention has been given to research relating to mental hygiene in industry, the objects of the research being to develop or discover methods for adapting psychopathetic individuals to usefulness in industry.

Realising, further, that mental hygiene dealt with only one of the many elements of the industrial *personnel* problem, the foundation board, in association with the National Research Council, arranged for the appointment of a committee representative of anthropology, psychology, educational relations, industrial relations, engineering, and medicine to consider means for furthering the study of the problems of industrial employment.

Quite apart from such efforts, the engineering foundation has interested itself in an attempt to co-ordinate the activities of many of the very numerous societies and associations, some local, some national, having a bearing on engineering, and to harmonise their relations and aims. Up to the present, however, no active investigational work along these lines has been undertaken. While the foundation maintains the closest relationship with the divisions of engineering of the United Engineering Society and the National Research Council, it reserves the right to conduct under its own immediate direction such researches as may commend themselves to its membership.

The administration of the engineering foundation is conducted by sixteen members elected by the United Engineering Society, thirteen of whom must be members of the founder societies. Although finally organised only in the early part of 1915, the foundation has become thoroughly established, and is carrying on a most admirable work.

A. P. M. FLEMING.

African Softwoods for Pulp Production.

By A. H. UNWIN,
Late Senior Conservator of Forests, Nigeria.

ABOUT the year 1907, at the instigation of the late Sir Alfred Jones, an inquiry was addressed to the West African Colonies with regard to the softwoods suitable for paper or pulp production. As a result a list was compiled for the Benin country, which included some twenty species of whitewood. Since that date little or nothing has been done towards the solution of this problem. Nevertheless, much greater knowledge has been obtained of the softwoods of the West African Colonies—the Gambia, Sierra Leone, Gold Coast, Nigeria—and of West Africa generally.

Although baobab (*Andansonia digitata*) has been suggested as suitable, it is usually found rather remote from navigable waterways, and in such scattered quantities that it is doubtful if its exploitation will pay. On the other hand, the wood of the cotton-tree, *Eriodendron anfractuosum* and *E. orientale*, has been adversely reported upon, but it does not appear that very exhaustive experiments were made with either of these species. The ease of its production, the rapidity of its growth, and the softness of its wood would seem to commend the cotton-tree for pulp production. The wood of *Bombax buonopozense* may also be of use.

Perhaps a more suitable wood will be obtained from the African maple, *Triplochiton Johnsonii* and *T. nigericum*. The wood of both these species is of about the same hardness as that of spruce. It is of a similar colour, and the fibres are long. The tree is very prevalent, its reproduction easy in the proper localities, and its growth rapid. On average soil the trees reach pulp-wood size within ten years, and there are many specimens even in seven years.

In certain localities the occurrence of *Sterculia Barterii* is such as to redden the hill-sides with its flowers in March. The growth of the tree is very rapid, and the wood is fibrous and porous. The tree will attain pulp-wood size in five years. In suitable localities the natural reproduction from mature trees is rapidly filling the whole forest.

Other Sterculiæ, such as *tomentosa*, *rhinopetala*, and *tragacantha*, might be used. Of these the last-named appears to be the most suitable. It is also very prevalent, and grows rapidly. The wood of *Sterculia rhinopetala* may prove to be a little hard, but with modern means of pulping it may be possible to use all these species at the same time.

The quantity of bamboo on the West Coast of Africa is negligible, though the area of its distribution is gradually widening.

The Albizzias usually produce in their younger stages a whitish-yellow softwood. Most species grow very fast, and would yield pulp-wood within ten years. The wood shows long fibres. Owing to the prevalence of the tree in the forests, there would be no difficulty as to the quantity. The wood of *Terminalia superba* should prove of value, though its brownish tinge may have to be removed in order to make the best-coloured pulp. It is prevalent and its growth is rapid.

Another very common tree is *Alstonia congensis*, which is often found in the swamps as well as in the moist forests. Its growth is very rapid, and it would yield pulp-wood in seven years. Owing to its prevalence, this softwood with its longish fibre should prove of value.

The wood of *Ricinodendron Heudelotti* appears to be suitable, though the colour is dull grey-brown. The tree is very prevalent, and its natural regeneration prolific. It reaches pulp-wood size within a period of seven to ten years. *Pycanthus komba* is another tree which appears to yield a suitable species of timber. It is very prevalent, the wood is soft and fibrous, and natural reproduction is great. Even the much-despised *Musanga Smithii* might on occasion be used to supplement inadequate supplies of other pulp-wood timbers. Near the rivers in some districts there is a common tree named Otu, which is planted by the natives. It yields a soft whitewood which has a longish fibre.

With the great shortage of paper-pulp it appears that the utilisation of these West African species of trees should be undertaken as soon as possible. Naturally, it will mean a good deal of experimental work, but with the experience already gained in Canada and Norway and Sweden it should be possible to produce pulp below existing cost. Although African labour is expensive as compared with Indian or Burman, it has proved itself thoroughly adaptable to training in the use of complicated machinery such as that employed in shipbuilding and in oil- and saw-mills.

With a population of about sixteen millions of people in Nigeria alone, it has been found possible gradually to obtain sufficient men for a new industry.

Effect of Topography on Precipitation in Japan.

CONSIDERABLE attention has been directed recently to the subject of the orographical distribution of rainfall, and results obtained in different places are liable to lead to general deductions, not only independent, if not quite contradictory, but also, on the face of them, improbable. We may instance an alleged connection between Indian monsoon intensity and the extent of local water surfaces, and also M. Mathias' cartographical demonstration that the increase of precipitation with altitude is directly dependent on the latitude, at any rate in France. Mr. Carle Salter's lecture to the Institution of Water Engineers on the relation of rainfall to configuration gave little ground for suspecting either of these possibilities.

At first sight, Prof. Terada's contribution in the Journal of the College of Science, Tokyo Imperial University (vol. xli., art. 5), appears to be only a supplement to previous work of Profs. Nakamura and Fujiwhara, but one or two comparatively fresh notes are struck. Prof. Omori had previously found a correlation between earthquake frequency in some districts and precipitation in others. This is now described by Prof. Terada as a case more of parallelism than of cause and effect, for he prefers to attribute both phenomena to barometric changes rather than to associate the instability of the soil with percolation. His main purpose, however, is to study the effect of the discontinuity of wind velocity on land and sea, and for this purpose he divides Japan into six districts, three facing the ocean and three the Japan Sea, and in each district chooses two or three stations near the coast.

The three "ocean" divisions show a marked increase in rainfall with decreasing latitude, but on the con-

tinental side the middle section is the wettest. Moreover, taking the divisions in pairs, there is a marked difference in the comparison. In the northern and central pairs the "continental" section is the drier, while in the remaining pair the difference is greater and also reversed in sign. Prof. Terada connects this anomaly with a possible "centre of action" controlled by the position of the Korean promontory, but it seems to be quite possible that he has overlooked the probable effect of the contour of the land itself. A glance at the map will show that his southernmost "ocean" division is practically outside the main island, which includes the northern and central divisions and the greater part of the continental southern division, so that we should naturally expect some sort of anomaly in that region, apart from the fact that the vertebral line of division, which is not far from a meridian in the north, tends to become more nearly a parallel in the south.

The author has adopted a good plan in using percentages instead of totals to prevent undue emphasis being placed on the wettest periods and places.

W. W. B.

Economic Entomology in the Philippines.[1]

A CONSIDERABLE portion of the Bulletin before us is the outcome of work undertaken with the definitely economic object of procuring and transporting to the battlefield natural enemies of the beetle *Anomala orientalis*, which, by reason of the havoc wrought in the larval stage on the roots of the sugar-cane, is a serious pest in the plantations, and was causing heavy losses in the Island of Oahu, Hawaii. It is gratifying to learn that the quest of the entomologists was entirely successful, and that through their labours the foe appears to have been vanquished, and thereby all mankind benefited in the saving of large quantities of one of our most valuable articles of food. The ally which the entomological staff summoned to the aid of the sugar-planters was the "wasp" *Scolia manilae*. It is perhaps prudent here to indicate that the term "wasp studies" must not be understood to apply solely to the true Diplopterous wasps, the Vespidæ; it is used in this publication as a convenient term including many families of aculeate Hymenoptera other than the bees.

Scolia manilae is a small black and yellow wasp that occurs abundantly in the Philippines. The females possess the power of detecting the presence of certain subterranean beetle grubs, and, having located their victim, dig down to it and deposit on its ventral surface an egg from which there soon emerges a larva that devours the beetle grub. The plan of campaign was simple. At Los Baños quantities of females of *Scolia manilae* were captured and placed in suitable vessels in which had been placed beetle grubs of appropriate age, and a sprig of foliage moistened with water and honey for the personal benefit of the wasps. Most of the grubs duly received an egg; those so favoured were placed in clay cells which were packed in soil in a tightly closed can, and then shipped to Oahu. Here the Scoliæ of the next generation emerged and were liberated. They established themselves with such success and increased so rapidly that they are now more abundant near Honolulu than at their native place, Los Baños, while the pest *Anomala orientalis* is vanishing so satisfactorily as to cause wonder how the wasp maintains itself.

The authors describe and figure twenty-six new species belonging to several different families of "wasps"; and the bionomics of these and others are narrated with great detail by Dr. Williams. His observations show that many species of these "wasps" are of economic importance in keeping in check the numbers of harmful insects, and suggest that an important line of research is here open to the field-naturalist. From the purely scientific point of view, perhaps the most interesting feature of the Bulletin is the frequency with which instincts and behaviour that are characteristic of the most highly developed social wasps manifest themselves sporadically and in an incipient fashion among these solitary species. So much is this the case that it becomes almost possible to construct a gradually ascending series from the simplest to the most highly specialised. Commencing with species that differ but little in habits from the Ichneumonidæ, stinging and only temporarily paralysing their victim in order the better to attach their egg, but constructing no nest or burrow of any description, we may pass on to those that dig burrows or build nests either unaided or in company with a few other individuals, and reach the climax in the elaborate domestic arrangements and architecture of our familiar social wasps and hornets.

O. H. L.

[1] "Philippine Wasp Studies." Part i., Descript'on of New Species. By S. A. Rohwer. Part ii., Descriptions of New Species and Life-history Studies. By F. X. Williams. Report of Work of the Experiment Station of the Hawaiian Sugar Planters' Association. Entomological Series. Bulletin No. 14. Pp. 186+106 figs. (Honolulu, December, 1919.)

Climate of the Netherlands.

THE Royal Netherlands Meteorological Institute has recently issued, as publication No. 102, "The Climate of the Netherlands with Respect to Air Temperature," by Dr. Ch. M. A. Hartman. Many years have elapsed since any previous discussion of air temperature in the Netherlands was undertaken. The stations yielding observations only for recent years have been compared with the stations available for longer periods, by which, together with the aid of stations affording hourly observations, special corrections have been found for each month and for each station required to secure the true temperature from observations at the hours of 8, 2, and 7. At Zwanenburg, situated midway between Amsterdam and Haarlem, there is a series of observations from 1743 to 1860, and at De Bilt observations are available from 1849 to 1917. The annual variation is given for twenty-four years from 1894 to 1917 inclusive at twelve stations; the range of temperature varies with latitude and with an increased distance from the sea. Diurnal variation is much affected by the influence of the sea, which suggests the difficulty of obtaining a true mean temperature from a combination of, say, three hours, 8, 2, and 7, and of maintaining the same hours in winter and in summer, but a change of hours is recognised as not practicable. The highest temperatures observed are 99° F. and 97° F. at Maestricht respectively on August 4, 1857, and July 28, 1911, and 97° F. at Oudenbosch on June 8, 1915. The lowest readings are −8° F. at Winterswijk on February 7, 1895, and at Katwijk-on-Rhine on February 14, 1895. Frequency of different temperatures is given for several stations and for all months, and the occurrences of diurnal variations of temperature for each degree Centigrade are tabulated, also the diurnal range for each of the twenty-four hours. One of the many tables shows the temperatures which occur each month, with the different directions of the wind.

The Present Condition of the Aborigines of Central Australia.

INFORMATION lately received in this country discloses an appalling condition of affairs among the aborigines of the interior of Australia. The whole population is thoroughly polluted with disease, both tubercular and venereal, and the north-eastern tribes are doomed. It is anticipated that another ten years will see the last of such interesting tribes as the Dieri, Yanntowanta, Ngameni, and Nauroworka. This is largely due to contact with the lower elements of European and immigrant Asiatic civilisation. Misdirected kindness, however, is also, to some extent, responsible. A liberal supply of Government blankets has been distributed among the tribes; they wear the blankets when working in the sun, and then, when thoroughly overheated, sleep on the ground; pneumonia follows as a natural consequence. Another cause of their disappearance is due to the difficulties attendant on food-supply. The game on which they subsist is killed off or driven away by the encroachment of civilisation. Distress from this cause has recently been aggravated by severe drought. The extent of the ravages arising from these various causes may be gauged by the fact that half a century ago it was estimated that there were 12,000 aborigines within 180 miles north and 200 miles east of Adelaide, and now there are not more than about 120 in that area. In the early eighties of last century Gason stated that if steps were not taken, multiplication of the aborigines would result in the disappearance of the European population, yet in this same area of which he wrote it is now estimated that at the outside there are not more than 2000.

The deplorable condition of the aboriginal population was discovered owing to the fact that during the war a number of expeditions were sent out to Central and Northern Australia in connection with the search for minerals for use in munition work. Dr. Herbert Basedow, a Protector of Aborigines in the service of the South Australian Government, who was a member of several of these expeditions, was then brought into close contact with the tribes. On his return to Adelaide at the end of the war he endeavoured to arouse the public conscience by a meeting in the Town Hall, at which he gave an undisguised account of what he had seen. As a result 500*l.* has been subscribed, and an equal amount promised by the Government, for the provision of medical relief. This sum has enabled Dr. Basedow to get together a small relief party. His first expedition on this work followed the course of the Strzelecki to Innamincka, thence along the Cooper, across the boundary into Queensland. Recrossing the border, the party visited Cordillo, Cadelga, Ringamurra, and Birdsville, thence following the Diamantina to Hergott Springs. One of the severest droughts on record was raging at the time; the heat was terrific—the average temperature was 116°–118° F.—and sand-storms blew for forty-eight hours at a time. No fewer than seven horses were abandoned exhausted along the route from Diamantina to Hergott Springs. The condition of the aborigines along the route is described by Dr. Basedow as "shocking." Dr. Basedow has recently started on another expedition, on which he proposes to proceed along the head of the Australian Bight as far as Eucla, along the Nullarboi Plains to Port Augusta, thence northwards to Oodnadatta, and across the boundary to the McDonnel Ranges.

Valuable as is such provision of medical relief as is possible by these expeditions, it is obviously only a temporary palliative. One of the most effective of the measures adopted for the assistance of the aborigines, whether directly under State protection or not, in the neighbouring State of Western Australia has been the establishment by the Government of a regular medical service. Further, while undesirable Europeans and Asiatics are permitted to mingle without control with the natives, it is inevitable that diseases will continue their ravages unchecked. A movement, which is receiving influential support, has been set on foot to induce the Government of South Australia to proclaim the north-west corner of the State, including the Musgrave, Mann, and Tomkinson Ranges, as an absolute reservation. It is hoped that it may also be possible to secure from the Commonwealth and the Western Australian Governments the proclamation of the adjoining ranges of the Northern Territory and Western Australia as strict reservations. This will probably be the last chance of preserving the Central Australian tribes from complete extinction.

E. N. FALLAIZE.

University and Educational Intelligence.

CAMBRIDGE.—Dr. Shillington Scales has been appointed University lecturer in medical radiology and electrology, and Mr. F. Lavington, Emmanuel College, Girdlers' lecturer in economics. Mr. J. Chadwick, Gonville and Caius College, has been elected to the Clerk Maxwell scholarship in experimental physics; Mr. H. F. Holden, St. John's College, to the Benn W. Levy research studentship in biochemistry; and Mr. A. J. Beamish, of Corpus Christi College, to the Wrenbury scholarship in economics.

The Marshall herbarium, comprising 23,000 sheets of British plants contained in dustproof oak cases, has been bequeathed to the University by the late Rev. E. S. Marshall, a keen and able field botanist, "unsurpassed as a collection of the critical flowering plants both in point of the number of interesting things he found and the care and industry he showed in selecting and pressing specimens of them."

EDINBURGH.—The foundation-stone of the new University buildings was laid by the King on Tuesday last, and the Queen accepted the honorary degree of LL.D.

LIVERPOOL.—The King, on the recommendation of the Chancellor and Council of the Duchy of Lancaster, has contributed 100 guineas to the appeal fund.

SHEFFIELD.—Dr. W. E. S. Turner has been appointed professor of glass technology, Mr. J. Husband professor of civil engineering, Dr. Mellanby professor of pharmacology, and Mr. R. E. Pleasance demonstrator in pathology.

By an inadvertence these appointments were given in NATURE of June 24 under the heading "Leeds."

PROF. F. FRANCIS has been appointed Pro-Vice-Chancellor of the University of Bristol in succession to Prof. Lloyd Morgan, who is about to resign the office.

DR. O. C. BRADLEY, principal of the Royal (Dick) Veterinary College, Edinburgh, has been elected president of the Royal College of Veterinary Surgeons in succession to Mr. J. McKinna.

A SCHOOL of medicine, surgery, and dentistry in connection with the University of Rochester, New York, has received an endowment of 1,800,000*l.* from the U.S. General Education Board and Mr. G. Eastman, of the Eastman Kodak Co. The contribution of the Board is 1,000,000*l.*, and that of Mr. Eastman 800,000*l.*

THE Eugenics Education Society has arranged for the holding of a summer school of eugenics and civics at Herne Bay College on July 31–August 14. The inaugural address will be delivered by Prof. A. Dendy on "Evolution in Human Progress," and there will be lectures and discussions on heredity, biology, eugenics, and sociology. The address of the society is 11 Lincoln's Inn Fields, W.C.2.

A SUMMER school of civics is to be held, under the auspices of the Civic Education League, at the Technical Institute, High Wycombe, Bucks, on July 31 to August 14. There are to be lectures on maternity and child welfare work, analytical psychology, and reconstruction problems; and courses on civics, sex education, local and central government, and anthropology have been arranged for. Further particulars can be obtained from the Secretary, Summer School of Civics, Leplay House, 65 Belgrave Road, S.W.1.

AN important American academic change is announced in the simultaneous resignations of Dr. G. Stanley Hall as president of Clark University and of Dr. Edmund C. Sanford as president of Clark College, and the appointment of Dr. Wallace W. Atwood as single head of both the University and the college. Dr. Atwood has been professor of physiography at Harvard since 1913, and is at present in the West in charge of a field expedition for the U.S. Geological Survey. In addition to his executive position, he will occupy the chair of regional and physical geography at Clark University. Dr. Stanley Hall is retiring in order that he may devote his whole time to the completion of several books on psychology which he has had in hand for a considerable period. Dr. Sanford will take the chair of psychology at Clark University, which Dr. Stanley Hall is vacating together with the presidency.

WE learn from *Science* that the following appropriations have recently been made by the U.S. General Education Board:—To the Washington University Medical School, St. Louis: For endowment, 250,000*l.*; for additional laboratory facilities and equipment, 14,000*l.* To Yale Medical School: For endowment (towards a total of 600,000*l.*), 200,000*l.* To Harvard Medical School: For improved facilities in obstetrics, 60,000*l.*; for the development of teaching in psychiatry, 70,000*l.* To Johns Hopkins Medical School: For development of a new department of pathology (towards a total of 120,000*l.*), 8000*l.* From the same source we learn that the Rockefeller Foundation has made appropriations as follow:—To Dalhousie University Medical School, Halifax: For buildings and equipment, 80,000*l.*; for endowments, 20,000*l.* To the Medical Research Foundation of Elisabeth, Queen of the Belgians, Brussels: For general purposes of medical research, 1,000,000 francs.

THE frontier between school and university has recently been the subject of much discussion. The Prime Minister's Committee on Science recommended that eighteen should be the normal age of entry from secondary schools to the universities, and in making that recommendation it was supported by all the witnesses who gave evidence on the subject. The Board of Education, by its efforts to standardise the Second School Examinations, and by watching the advanced courses given in schools, has done much to direct the studies of those who really are in the post-matriculation stage while at school; and the universities are faced, more than ever before, by the problem of how to arrange for students who enter with wide differences of attainment. There is but one solution: elasticity of organisation, both in the matter of examinations and in that of prescribed courses. During the past year a consultative council, on which were representatives of seven universities and four associations of school teachers, has been formed by the Association of Science Teachers in order to discuss the overlapping of school and university training. As a result, a resolution was sent to the various universities urging them "to recognise the value of the post-matriculation work in efficient schools by accepting the passing in subjects in one of the approved Second School Examinations as exempting from the corresponding subjects in the Intermediate Examination and the first Medical Examination of the University." The Association of Science Teachers is to be congratulated on organising the discussions which have led to this expression of opinion by a body well constituted to view the situation from opposite sides.

Societies and Academies.

LONDON.

Faraday Society, June 14.—Prof. A. W. Porter, vice-president, in the chair.—Dr. A. **Fleck** and T. **Wallace**: Conduction of electricity through fused sodium hydrate. The resistance to the passage of current through fused caustic soda and its rate of change with temperature have been examined by a direct-current method. In view of the difficulties of containing the soda in a non-conducting non-porous vessel, the experiments have been carried out in the centre of a large mass of soda. The decomposition voltage has been studied and found to be a variable quantity, decreasing at the rate of $2{\cdot}25 \times 10^{-3}$ volts per degree Centigrade rise in temperature. This figure differs from the previously published figure of $2{\cdot}95 \times 10^{-3}$. It has been found that when a current is passed through fused sodium hydrate between two sodium electrodes the current is always proportional to the applied E.M.F.—Dr. H. F. **Haworth**: The measurement of electrolytic resistances using alternating currents. An electrolytic cell acts like a capacity in series with a resistance. If this capacity and resistance be measured at various frequencies, they will be found to vary with the frequency. If the impedance of the cell is plotted vectorially with respect to the resistance for various frequencies, the locus is a straight line which cuts the resistance axis at infinite frequency. This gives the true resistance of the electrolyte.—J. L. **Haughton**: The measurement of electrical conductivity in metals and alloys at high temperatures. The study of the electrical conductivity of alloys has generally been carried out by measuring the conductivity of the alloys at room-temperature and plotting a curve connecting conductivity with composition, but much valuable information can be obtained by plotting the curve connecting the composition and temperature and using a series of such curves in the same way as the ordinary thermal curves. The paper describes a method which can be employed for this.—N. V. S. **Knibbs** and H. **Palfreeman**: The theory of electro-chemical chlorate and perchlorate formation. This paper is the outcome of a study of the electrolytic formation of chlorate and perchlorate based on recent large-scale operations. It aims at a presentation of the theory of the mechanism of chlorate and perchlorate formation and its application to their technical production. A series of investigations was undertaken in order to elucidate a number of doubtful points and to obtain data which were of importance in the technical control of the process.—J. B. **Firth**: Sorption of iodine by carbon. The sorption of iodine by carbon was studied over a period of five years; the forms of carbon used were lampblack, blood carbon, sugar carbon, animal carbon,

coconut carbon from shell, and coconut carbon from fruit. The solvents used were chloroform and benzene. The activity of the carbon was shown to depend on its previous treatment. In all cases a rapid condensation takes place in the first few minutes, followed by a much slower sorption, which may continue for several years. The influence of the size of the carbon particles was also studied.—F. H. **Jeffery**: Electrolysis of solutions of sodium nitrite using a copper anode.—Dr. A. M. **Williams**: The pressure variation of equilibrium constant in dilute solution. The apparent discrepancy between the expressions of Planck and Rice rests on a misinterpretation of the latter's symbols. Another deduction is given.—Miss Nina **Hosali**: Models illustrating crystalline form and symmetry.

Linnean Society, June 17.—Dr. A. Smith Woodward, president, in the chair.—(The centenary of the death of Sir Joseph Banks.)—Dr. B. Daydon **Jackson**: Banks as a traveller.—Dr. A. B. **Rendle**: Banks as a patron of science.—J. **Britten**: Banks as a botanist.—Dr. A. Smith **Woodward**: Banks as a trustee of the British Museum of paramount power.

June 24.—Dr. A. Smith Woodward, president, in the chair.—Dr. C. J. F. **Skottsberg**: Botanical features of the Juan Fernandez group of islands.—Dr. R. J. **Tillyard**: The Cawthron Institute. This institute is to be situated in the city of Nelson, N.Z. An account was given of the early life and adventures of the founder, showing how he rose from a low estate to become a very wealthy man. In his later years he busied himself with philanthropic enterprises, and on his death it was found that he had left the greater portion of his fortune for the purpose of founding an institute of scientific research. After all claims had been paid, the Cawthron Trust was left with a capital of about 200,000*l*., which, wisely invested, would yield an income of about 11,000*l*. a year. Prof. T. H. Easterfield, of Wellington, N.Z., has been appointed director and chief of the chemical department, with Mr. T. H. Rigg, late of Rothamsted, working under him as agricultural chemist. In the biological department Miss K. M. Curtis has been appointed mycologist, and Mr. A. Philpott assistant entomologist. The library and museum are under the care of the curator, Mr. W. C. Davies. The activities of the institute will be directed towards scientific research, both pure and applied, with the view of benefiting the primary industries of New Zealand as a whole and of the Nelson Province in particular.

Aristotelian Society, June 21.—Mr. A. F. Shand in the chair.—Miss **Edgell**: Memory and conation. The views of three writers approaching the subject from the different viewpoints of philosophical psychology, biology, and psychiatry, viz. Prof. Ward, Dr. Semon, and Dr. Freud, were examined with reference to the question: Does memory require the recognition in mental life of a specific function, conation? Analysis shows that for Prof. Ward the activity of the subject of experience is essential both for the development of memory and for many of its manifestations. If the activity of the subject be understood as implying conation, then the author's theory of memory does involve conation. Dr. Semon, following Hering and Butler, regards memory as a function of all organic matter and its laws as laws of organic life. Nevertheless, in dealing with human memory Semon recognises "vividness" in imagery as essential for memory and association. Vividness is distinguished from intensity and made to depend on attention. The relation of attention to the laws of organic life is still obscure, and attention is treated as if it were an original force. The *rôle* of conation in the psychology of Dr. Freud is all-important. It is the conation of unconscious wish which is regarded as explanatory, if not of the fact of memory itself, at least of many of the phenomena of remembering and forgetting in everyday life.

PARIS.

Academy of Sciences, June 21.—M. Henri Deslandres in the chair.—The President announced the death of Adolphe Carnot, free member.—L. Torres Quevedo was elected correspondant for the section of mechanics in succession to the late M. Boulvin.—P. **Humbert**: Functions of the hyperparaboloid of revolution and hyperspherical functions.—J. **Villey**: The choice of the density of filling in the conception of aviation explosion motors.—R. **Jarry-Desloges**: Different phenomena observed on the planet Mars in the present opposition. Nix Olimpica was discovered by Schiaparelli in 1879, but no measurements have been taken since that date. Searches without result were made in 1881 by Schiaparelli, and in other observations between 1907 and 1916. The concordance between the measurements made at Milan in 1879 and those taken at Sétif in 1920 leave no room for doubt that Nix Olimpica has reappeared.—Mme. Paule **Collet**: Two modes of rectification of currents by galena.—E. **Berger**: Some reactions started by a primer. The use of a primer to start a chemical reaction instead of an external application of heat was first used by Goldschmidt, a mixture of barium peroxide and magnesium powder being employed to start the reaction between ferric oxide and powdered aluminium. The new primer proposed by the author consists of 60 per cent. potassium nitrate (or sodium nitrate) and 40 per cent. commercial calcium silicide. This burns with a very high temperature, and can be lit with a match. A description is given of the applications of this method to the production of phosphorus and arsenic, the reduction of the sulphates of the alkaline earths by phosphorus, and the preparation of the fluorides of silicon and boron.—A. **Recoura**: The constitution of the grey lilac chromium sulphate.—P. **Jolibois** and P. **Bouvier**: The precipitation of mercuric salts by sulphuretted hydrogen. The authors have applied the apparatus described in an earlier communication to the study of the reaction between mercuric chloride and hydrogen sulphide, the reaction being carried out with the two reagents in varying proportions. With excess of sulphuretted hydrogen the precipitate has the composition HgS; with the mercuric chloride in excess the precipitate (white) has the composition $2HgS,HgCl_2$, and there was no indication of the existence of any other intermediate compound.—P. **Chevenard**: The thermal change of the elastic properties of nickel-steels. The results of experiments on twenty-eight alloys of iron and nickel are given graphically in two diagrams.—A. de G. **Rocasolano**: The catalytic decomposition of solutions of hydrogen peroxide by colloidal platinum. Bredig and his pupils concluded from their experimental studies of this reaction that it was monomolecular. The author has used electrosols of platinum as catalyst, and comes to the conclusion that the reaction in this case is not monomolecular or of the first order. During the reaction the catalyst is changed. If some of this altered catalyst is added to a fresh quantity of hydrogen peroxide, the ensuing reaction is now monomolecular.—E. **Hildt**: The hydrolysis of the polysaccharides. Details of further experiments on the use of a mixture of sulphuric acid and sodium benzenesulphonate as a catalyst for the hydrolysis of the sugars. Glucose and galactose retain their rotatory and reducing powers unchanged under the action of this catalyst; non-lævulosic sugars, such as lactose and maltose, are

not hydrolysed at the ordinary temperature; whilst with saccharose and raffinose the lævulose is completely split off after sufficient time at the ordinary temperature or after one hour at 98° C.—L. **Cayeux**: The secondary quartz and the rhombohedral quartz in the iron minerals of the Longwy-Briey basin.—R. **Abrard**: The existence of the Aalenian stage in the massif of Zerhoun and at Djebel Tselfat (Western Morocco).—P. **Russo**: The alluvial terraces of Oum er Rbia (Western Morocco).—L. **Daniel**: Antagonistic reactions and the *rôle* of the pad in grafted plants.—A. **Guilliermond**: The structure of the plant-cell. Reply to a recent communication of M. Dangeard.—M. **Dangeard**: Reply to the preceding note.—E. **Licent**: The use of mixtures of formal and chromium compounds as fixing agents. Three formulæ are given for fixing reagents containing formal, chromic acid, and acetic acid in different proportions. Although the use in the same liquid of a powerful oxidising agent and a reducing substance would appear to be irrational, long experience has shown that such mixtures give excellent results.—E. **Roubaud**: The use of trioxymethylene in powder for the destruction of the larvæ of mosquitoes. Trioxymethylene exerts a specific toxic action on these larvæ, and has advantages over petroleum and other reagents in use. Detailed instructions for the best application of the trioxymethylene are given.—J. **Nageotte**: The toxicity of certain dead heterogeneous grafts.—A. **Goris**: The chemical composition of the tubercle bacillus. A new substance has been obtained from tubercle bacilli by extraction with chloroform and subsequent purification by precipitation from chloroform solution with ether, the fats remaining in solution in the ether and the new substance, named hyalinol, being precipitated. Seven grams were obtained from 1500 grams of the bacilli. An analysis and some reactions of the hyalinol are given.—R. **Ducloux**: The formation of asporogenic races of *Bacillus anthracis*. The attenuation of its virulence.—MM. A. **Trillat** and **Mallein**: Experiments on the transmission of an infectious disease in animals by the intermediary of air. Influence of the temperature.—MM. A. **Mayer**, **Guieysse**, **Plantefol**, and **Fauré-Fremiet**: Pulmonary lesions determined by blistering compounds. Studies on the pulmonary lesions caused by the inhalation of vaporised or pulverised dichloroethyl sulphide on the dog, rabbit, and guinea-pig.

Books Received.

Techno-Chemical Receipt Book. Compiled and edited by W. T. Brannt and Dr. W. H. Wahl. Pp. xxxiii+516. (London: Hodder and Stoughton, Ltd.) 15s. net.

Psychoneuroses of War and Peace. By Dr. M. Culpin. Pp. vii+127. (Cambridge: At the University Press.) 10s. net.

Reports of the Department of Conservation and Development, State of New Jersey. Annual Report for the Year ending June 30, 1919. Pp. 115. (Trenton, N.J.)

The Science Reports of the Tôhoku Imperial University. 1st Series. (Mathematics, Physics, Chemistry.) Vol. ix., No. 2, April. (Tokyo: Maruzen Co., Ltd.)

Meddelanden från Lunds Astronomiska Observatorium. Serie ii., Nr. 22: A Study of the Stars of Spectral Type A. By H. G. Malmquist. Pp. 69. (Lund.)

The Journal of the Royal Agricultural Society of England. Vol. lxxx. Practice with Science. Pp. viii+438+cli. (London: J. Murray.) 10s.

Diary of Societies.

THURSDAY, JULY 8.

ROYAL SOCIETY OF MEDICINE (Obstetrics and Gynæcology Section), at 8.—G. Ley: The Pathology of Accidental Hæmorrhage.

FRIDAY, JULY 9.

WEST LONDON MEDICO-CHIRURGICAL SOCIETY (at the West London Hospital), at 5.—Annual General Meeting.

SATURDAY, JULY 10.

PHYSIOLOGICAL SOCIETY (at Physiological Laboratory, University, Oxford), at 4.—J. B. Leathes and H. C. Broadhurst: Excretion of Phosphate.—J. Barcroft and F. J. Roughton: Diffusion Co-efficient of Lung.—S. P. L. Sørensen and E. J. Cohn: Solubility of Globulin.—A. Krogh: Reaction of Blood Vessels to Local Stimuli.

TUESDAY, JULY 13.

SOCIETY FOR THE STUDY OF INEBRIETY (at the Medical Society of London), at 4.—A. Evans and Others: Discussion on Alcohol and Alcoholism in relation to Venereal Disease.

WEDNESDAY, JULY 14.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (in Canada Building, Crystal Palace), at 6.—H. Barringer: Oil Storage, Transport, and Distribution (Free Public Lecture).

THURSDAY, JULY 15.

ROYAL SOCIETY OF MEDICINE (Dermatology Section), at 5.
RÖNTGEN SOCIETY (at University College), at 9.—Dr. W. D. Coolidge: Address (Special Open Meeting).

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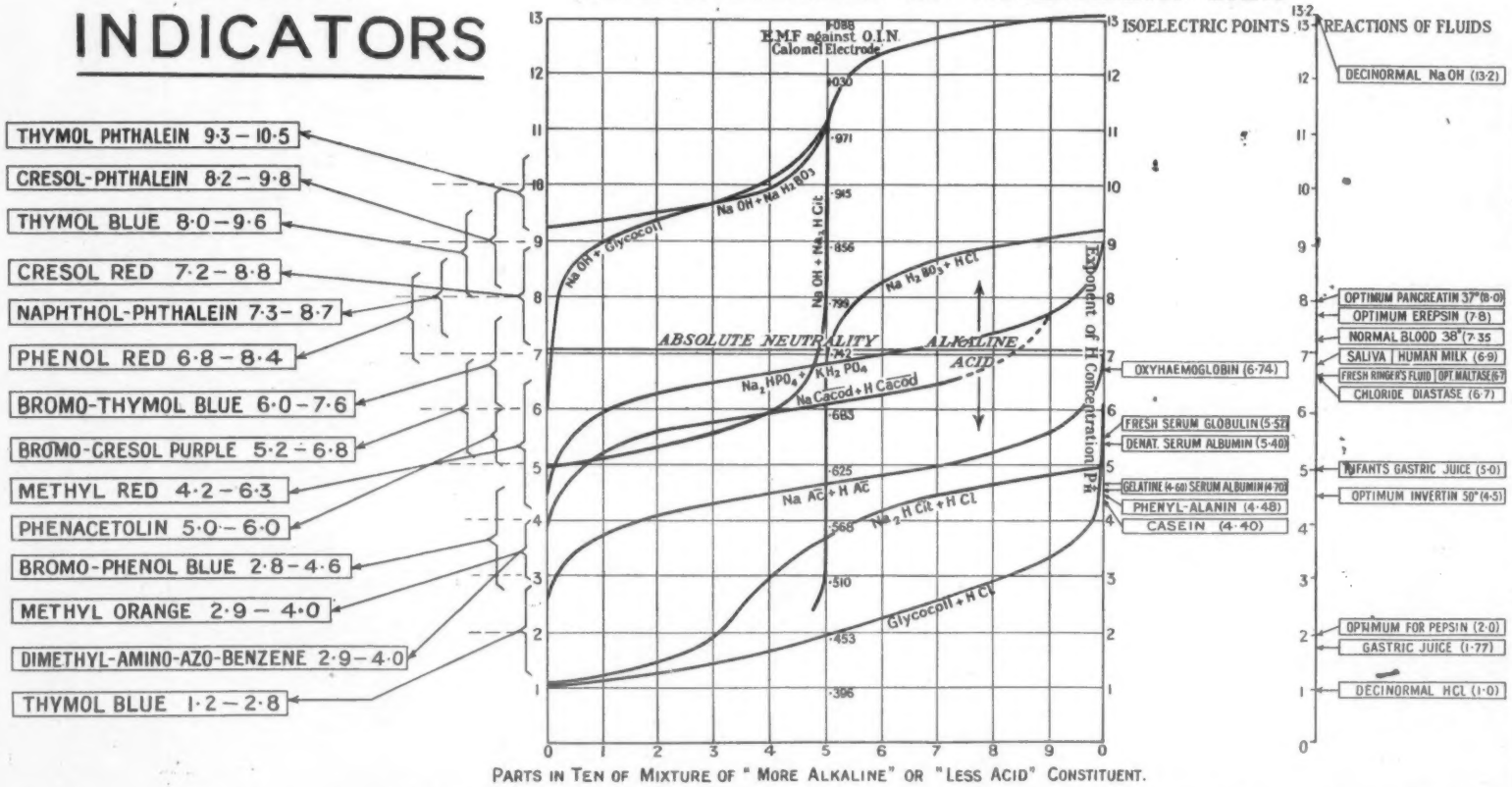
B.D.H. INDICATORS

CHART OF HYDROGEN ION CONCENTRATION DATA



The Sörensen solutions are: 0·10 N HCl; 0·10 N NaOH; 7·505 g. glycocoll + 5·85 g. Na Cl. per litre: 11·876 g. $Na_2HPO_4 . 2H_2O$ per litre; 9·078 g. KH_2PO_4 per litre; 21·008 g. citric acid in 1 litre of 0·20 N NaOH; 12·404 g. boric acid in 1 litre 0·10 N NaOH; The other solutions are: 0·20 N sodium acetate, acetic acid, sodium cacodylate, cacodylic acid.

Price List on Application to

THE BRITISH DRUG HOUSES LTD., GRAHAM STREET, CITY ROAD, LONDON.

Supplement to "Nature," July 8, 1920.

SUDAN GOVERNMENT.

Applications are invited for the post of an additional ASSISTANT GOVERNMENT CHEMIST, Sudan, at an initial salary of £480 plus £120 temporary war bonus.

Candidates should possess a good chemical degree and some knowledge of agricultural chemistry. The selected candidate will be expected to leave for the Sudan in September. Applications giving particulars as to age, education, scientific training and experience should be sent before July 25, to Dr. A. F. JOSEPH, 296 Willesden Lane, London, N.W., from whom further particulars may be obtained.

BIRMINGHAM MUNICIPAL TECHNICAL SCHOOL.

Principal—W. E. SUMPNER, D.Sc.

Applications are invited for the HEADSHIP of the CHEMICAL DEPARTMENT now vacant by the appointment of Dr. T. S. Price as Director of Research to the British Photographic Research Association.

Full particulars of the appointment can be obtained from the SECRETARY, Municipal Technical School, Suffolk Street, Birmingham.

BIRMINGHAM MUNICIPAL TECHNICAL SCHOOL.

Required in September next the full-time services of a LECTURER in METALLURGY.

The commencing salary offered will depend upon the previous training and experience of the candidate. For full particulars apply to the SECRETARY, Municipal Technical School, Suffolk Street, Birmingham.

UNIVERSITY OF LONDON.

The Senate invite applications for the UNIVERSITY CHAIR of RADIOLOGY tenable at Middlesex Hospital Medical School. Salary £1000 a year. Applications (12 copies) must be received not later than first post on Sept. 23, 1920, by the ACADEMIC REGISTRAR, University of London, South Kensington, S.W.7, from whom further particulars may be obtained.

STOCKTON-ON-TEES QUEEN VICTORIA HIGH SCHOOL.

Wanted in September :—

(1) SCIENCE MISTRESS.

(2) Either SENIOR MATHEMATICS MISTRESS able to offer Geography, or MISTRESS with Geography Diploma and Mathematics as a subsidiary subject.

Graduates with experience preferred. Salary £180-£15-£350.
Apply to the HEADMISTRESS.

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Applications are invited, up to July 20, for an OPEN FELLOWSHIP of £200 per annum, established by the Institution of Gas Engineers for the prosecution of post-graduate research in Gas Chemistry. For further particulars apply to the SECRETARY, the University, Leeds.

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SCIENCE and MATHEMATICS MISTRESSES required for September next. Salary in accordance with the Middlesex Scale. Apply immediately to HEADMISTRESS

HUDDERSFIELD TECHNICAL COLLEGE.

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Further particulars may be obtained on application to the SECRETARY, Technical College, Huddersfield.

UNIVERSITY OF EDINBURGH.

CHEMISTRY DEPARTMENT.

Several DEMONSTRATORS (University Assistants) are wanted to take up duty on October 1. The salary to commence is £250 per annum. Apply with statement of training and references to the SECRETARY, University, Edinburgh.

INDIA.—Wanted a gentleman interested in Natural History, under 30 years of age—unmarried—to be Curator of the Museum of the Bombay Natural History Society at Bombay, India. Five years' engagement. Salary commencing at Rs. 500 per month. Passage paid out and home.—Apply W. S. M., c/o Box No. 35, NATURE Office.

WANTED, ASSISTANT for Private Research Laboratory, Cambridge. Good knowledge of chemical technique essential. Physiological or biochemical experience advantageous.—1 ox 56, c/o NATURE Office.

WANTED, to share weekly (receive or send) "NATURE"—MITCHELL, Hensleigh Road, Tiverton, Devon.

BUCKS.

APPOINTMENT OF PUBLIC ANALYST.

The Bucks County Council invite applications from Candidates prepared to undertake all the duties of PUBLIC ANALYST in BUCKS under the Sale of Food and Drugs Acts, 1875 to 1907, at a fee of £1 1s. for each analysis for the first 100 in any financial year and of 10s. 6d. for each analysis over 100, with an additional £2 12s. 6d. for each quarterly Report, the engagement to be terminable by three calendar months' notice in writing on either side.

Applications in writing stating age and particulars of experience and qualifications (particularly as to skill in and knowledge of analytical chemistry, therapeutics and microscopy) with not more than three recent testimonials to be sent to the CLERK of the Bucks County Council, County Hall, Aylesbury, not later than August 14, 1920.

Forms of application may be obtained on application to the CLERK of the County Council at the above address.

Personal canvassing will disqualify.

BRIGHTON MUNICIPAL TECHNICAL COLLEGE.

Principal: W. MANSERGH VARLEY, M.A., D.Sc., Ph.D.

Applications are invited for the following positions :—

1. LECTURER in the DEPARTMENT of MATHEMATICS, fully qualified to take charge of classes in Pure and Applied Mathematics up to the standard of the Final Arts and Science Degrees of London University.
2. LECTURER in the DEPARTMENT of PHYSICS, fully qualified to take charge of classes in Physics up to the degree standard. Qualifications in Applied Electricity, though not essential, will be a recommendation.

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54 Old Steine, Brighton. F. HERBERT TOYNE, Secretary.

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Applications are invited for the following vacancies :—

LECTURER IN CHEMISTRY.
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LECTURER IN MECHANICAL ENGINEERING.

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Particulars may be had from the PRINCIPAL, to whom applications should be sent as early as possible and not later than July 19.

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Applications are invited for the post of LECTURER in AGRICULTURAL BOTANY. Full particulars may be had on application to the PRINCIPAL.

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UNIVERSITY OF BRISTOL.

ASSISTANT LECTURER IN ENGINEERING. £350-£10-£400.

For particulars and form of application send at once stamped, addressed, foolscap envelope to the REGISTRAR of the Merchant Venturers' Technical College.

MASTER required for Physics and some Elem. Maths. £250 resident or £300 non-resident and house. Public School.—Address, GRIFFITHS, POWELL & SMITH, Tutorial Agents, 12 & 13 Henrietta Street, Covent Garden, London, W.C. 2.

ASSISTANT WORKS CHEMIST wanted at once, preferably with Paper Mill experience.—Apply in writing in first instance, stating age, if married, full details of training, experience and salary required, to THAMES PAPER CO., LTD., Purfleet, Essex.

UNIVERSITY OF BRISTOL.

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Students' microscope by good maker for sale. —Particulars RICKMAN, 204 Hamlet Court Road, Westcliff-on-Sea.

LEITZ TRAVELLING MICROSCOPE, in fine leather case, with metal corners, ⅓, ⅙, 1/12 oil objectives, Abbe and iris. Complete weight, 11 lbs.; 36 guineas.—JOHN BROWNING, 146 Strand, London, W.C. 2.

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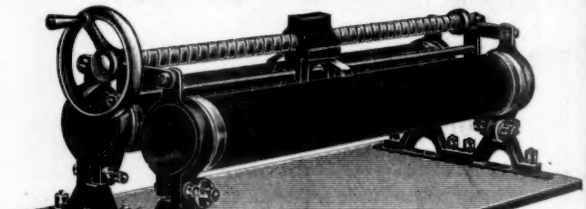

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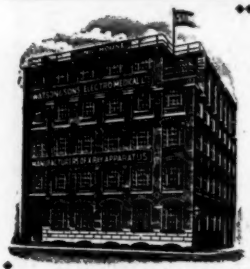

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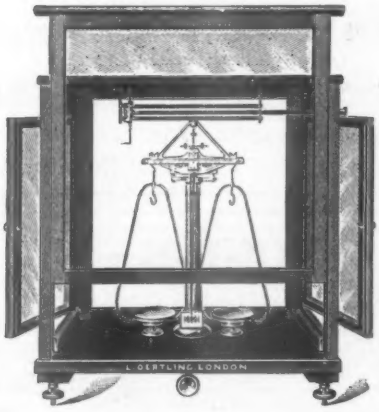

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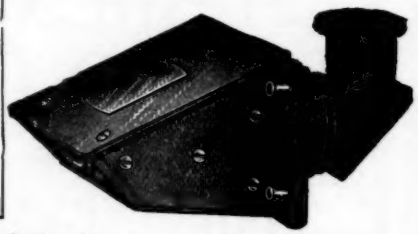

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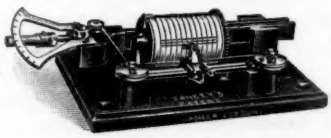

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